

**DOCKETED**

Volume II  
Pages 182 to 352  
Exhibits MIT 17 to 48

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS

----- X  
THE MAGNAVOX COMPANY  
SANDERS ASSOCIATES, INC.

v.

CIVIL ACTION  
74-C-1030

BALLY MANUFACTURING CORPORATION  
MIDWAY MFG. CO.  
EMPIRE DISTRIBUTING, INC.  
CHICAGO DYNAMICS INDUSTRIES, INC.  
----- X

CONSOLIDATED WITH  
CIVIL ACTION  
74-C-2510

IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF NEW YORK

----- X  
MIDWAY MFG. CO.

v.

**FILED**

APR 28 1976

CIVIL ACTION  
74-Civ.-1657-CBM

THE MAGNAVOX COMPANY  
SANDERS ASSOCIATES, INC.

H. STUART CUNNINGHAM, CLERK  
UNITED STATES DISTRICT COURT

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF CALIFORNIA

----- X  
ATARI, INC.

v.

CIVIL ACTION  
75-1442-WTS

THE MAGNAVOX COMPANY  
SANDERS ASSOCIATES, INC.  
----- X

**DORIS O. WONG ASSOCIATES**  
*Certified Shorthand Reporters*

24 MILK STREET BOSTON MASSACHUSETTS 02109

CONTINUED DEPOSITION of MASSACHUSETTS  
INSTITUTE OF TECHNOLOGY by JOHN ALEXANDER McKENZIE  
and of JOHN ALEXANDER McKENZIE individually, taken  
pursuant to the Federal Rules of Civil Procedure,  
before Jonathan H. Young, Registered Professional  
Reporter and Notary Public in and for the  
Commonwealth of Massachusetts, at Room E19-758,  
Ford Building, Massachusetts Institute of  
Technology, 50 Ames Street, Cambridge, Massachusetts,  
on Wednesday, October 29, 1975, commencing at 9:10  
a.m.

PRESENT:

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Midway Mfg. Co., and Empire Distributing,  
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**PRESENT: (Cont.)**

Louis Etlinger, Esq., Corporate Patent Counsel,  
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Technology.

17

Cardboard box containing  
punchboard paper 24" x 36"

18

Envelopes paper tape  
punched paper tape  
punched paper tape  
punched paper tape

19

Envelopes paper tape  
punched paper tape  
punched paper tape

20

Envelopes paper tape  
punched paper tape

21

Envelopes paper tape  
punched paper tape

22

Envelopes paper tape  
punched paper tape

23

Envelopes paper tape  
punched paper tape

# I N D E X

<u>Examination of:</u>	<u>Direct</u>	<u>Cross</u>
John Alexander McKenzie, I T S (Resumed)		
(Mr. Welsh, Continued)	187	
(Mr. Anderson)		339

## E X H I B I T S

<u>MIT No.</u>	<u>Description</u>	<u>For Iden.</u>
17	Cardboard box containing punched paper tapes.	196
18	Punched paper tape designated "David Gross - Space War with knobs and buttons 4/6/64."	196
19	Punched paper tape designated "Space War/m buttons and knobs 4G."	197
20	DECUSCOPE dated April 1962.	213
21	DECUS program library catalog dated November 1969.	217
22	DECUSCOPE dated May 1962.	224
23	DECUS Proceedings, 1962.	225

I N D E X (Cont.)E X H I B I T S (Cont.)

<u>MIT No.</u>	<u>Description</u>	<u>For Iden.</u>
24	DECUS document dated March 1965.	234
25 thru 45, 45-A, 46 thru 48	Group of blueprints.	273

1 JOHN ALEXANDER MCKENZIE, Resumed

2 DIRECT EXAMINATION, Continued

3 BY MR. WELSH:

4 Q Referring to Exhibit 16, which has an English  
5 leader, "Space War for Ralph," I believe you  
6 identified the various markings on that, the  
7 outside of that tape strip, beneath the dotted  
8 line.

9 Q How were you familiar, or how are you  
10 familiar, with what those markings mean?

11 A One of the -- well, the "11/" is our designation  
12 of location in core memory.

13 Q Did you use that designation with other programs?

14 A Yes; that's common. That's the designation when  
15 you use numerical address.

16 Q Did you become familiar with that through your  
17 dealing with programs with the PDP-1?

18 A Well, that's been carried on from the TX-0  
19 computer. It's been standard in our installation,  
20 at least; and it's carried through DEC computers  
21 in their software.

22 Q How about the other markings?

23 A That's the Law instruction, which means load  
24 accumulator with the number; and it's necessary

1 to refer to the handbook, Exhibit --  
2 Q 10.

3 A -- 10. And that's part of the order code; and  
4 the definition is in here. The heading is  
5 "Augmented Instructions. Load Accumulator with N  
6 (Five Microseconds)."

7 Q Does that appear on --

8 A Page 18. Sorry.

9 Q That's of Exhibit 10?

10 A Yes. "Law N Operation Code 70. The number in  
11 the memory address bits of the instruction word  
12 is placed in the accumulator. If the indirect  
13 address bit is one (minus N) is put in the  
14 accumulator."

15 The notation on here, I, refers to the  
16 the indirect address bit. In this case, it is a  
17 one; and what they're looking for here is the  
18 negative, the number minus 34,000. That means

19 Q When you say "what they're looking for here,"  
20 you're referring to Exhibit 16?

21 A Exhibit 16; specifically talking about the  
22 modification to address 11.

23 Q Did you use that instruction in connection with  
24 other tapes?

1 MR. ANDERSON: I object to the question.  
2 There's no foundation for it.

3 A Yes. That's used the same way as all instructions  
4 are used; and that's, well, the documented  
5 identification.

6 Q And do you know that from your own personal  
7 experience using the PDP-1?

8 A Yes.

9 Q Is the same thing true of the other markings  
10 under the line?

11 MR. ANDERSON: I object. You're  
12 leading the witness.

13 A The same thing would be true of the location 10/.  
14 It has the same instruction, "Law I 10." In  
15 this case, it means to put into Location 10 the  
16 number minus 10.

17 Q Are there any other markings?

18 A Yes. The other location; 16/20,000. That means  
19 load this location, or put into this location  
20 manually, by switches or from an interactive  
21 typewriter, the constant 20,000.

22 I'd like to backtrack a little bit on  
23 that Law. I think, in fact I know, the  
24 interpretation in this case is not the negative

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1 number. The end result -- I didn't state it  
2 quite clearly -- the end result, when it's  
3 executed, it has the effect of loading minus 34.

4 and it was. But this is indeed the instruction  
5 that says load the accumulator with minus 34. I  
6 talked towards what he wanted; but indeed the  
7 instruction that he put in there was the when he  
8 instruction load the accumulator with minus 34.

9 Q You say "what he wanted." How did you know what  
10 he wanted? very often they would be playing Space

11 A Well, that's what it tells you to do. could play.

12 Q And who is "he"? copy; so they brought in their

13 A Any user. or demonstrations, something like this.

14 Q I believe you stated that -- strike that. oh you

15 obtained. This exhibit, you testified, contains

16 a leader with English, Space War for Ralph. he box

17 A Yes. stified to yesterday; where I confiscated all

18 Q Is that correct? yes and put them together.

19 A Yes. This is what we call the title punch.

20 Q And was that Ralph Butler?

21 D. of that MR. ANDERSON: I object. The question  
22 has been asked and answered, I believe. Space

23 A Yes. Ralph at that time was doing wiring changes  
24 in the machines. He customarily came in at eight

1 in the morning and began the wiring. We came in  
2 somewhat later and started checking the machine.  
3 This was all done while there was user activity;  
4 and it was meant to be done in a fashion so as  
5 to minimize the inconvenience to the users.

6 Q Ralph had a good relationship with the  
7 students who normally were on the machine when he  
8 came in -- not normally; often were on the machine  
9 when he came in at seven in the morning; and one  
10 of these, very often they would be playing Space  
11 War, and he wanted his copy so that he could play.  
12 Most people had a copy; so they brought in their  
13 family, for demonstrations, something like this.

14 Q Do you recall the circumstances under which you  
15 obtained this particular tape?

16 A It was in the box labeled -- well, it was the box  
17 I testified to yesterday; where I confiscated all  
18 the Space War tapes and put them together.

19 Q It was in that box?

20 A Yes. Do you know approximately when that occurred?

21 Q Does that box contain any writings?

22 A Yes. There's a directory on the side; "Space  
23 War 3.1, Space War 3.2. Space War using nobs  
24 and buttons. Space War 2-B. Quickie Space War 19/

1 April/62."

2 Q Do you know who wrote those things there?

3 A No. It is not my writing. The writing on the  
4 top is mine, "Space War"; where I had these filed  
5 in a collection of similar boxes.

6 Q Do you recall when you wrote "Space War" on the  
7 top?

8 A I could not.

9 Q How long did Mr. Butler work for you?

10 A '62, '63, through '68 -- well, '69, '70. When I  
11 say '70, all these dates, I mean plus or minus  
12 a year. '69, pin it; say one.

13 Q Did you confiscate tapes over that entire period,  
14 or only a part of that period?

15 A That was a one-time occurrence.

16 Q The confiscation of the tapes?

17 A Yes.

18 Q That is, the tapes that you produced here?

19 A Yes.

20 Q And do you know approximately when that occurred?

21 A No.

22 Q Was it early in the playing of Space War on the  
23 PDP-1?

24 A No. It was not a nuisance at that time. It was

1 still recognized as a worthwhile endeavor. It  
2 was just when people started copying these tapes  
3 and putting new flourishes onto the modifications  
4 to this program and consuming a lot of consumer  
5 time. Consumer time later became tighter. The  
6 usage became directed more in the -- well, a  
7 combination of formal class activity and research  
8 activity; and there just wasn't time to allow  
9 people to be playing, which it was.

10 Q Did that occur within two years of the time  
11 Space War began to be played?

12 MR. ANDERSON: I object. You're  
13 leading the witness.

14 A I'd rather say five.

15 Q It occurred within five years?

16 A Yes. It was still while Jack Dennis was in  
17 charge. He agreed that it was worthwhile.

18 Q And that was before he went to Project MAC?

19 A Yes.

20 Q Do you know where Mr. Butler is today?

21 A When he left here, he left to take -- meaning  
22 when he left MIT -- he left to take an appoint-  
23 ment as a fireman in Scituate, Massachusetts.

24 Q Would you spell that, please.

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1 A S-c-i-t-u-a-t-e.

2 Q And is he still there, so far as you know?

3 A As of probably two years ago, he was still there.

4 Q Was there a user named Polis?

5 A Yes, Dan Polis.

6 Q Dan Polis?

7 A Yes; Daniel Polis.

8 Q Was he a student?

9 A Yes, he was.

10 Q Do you know what his middle name was?

11 A No.

12 Q I ask you to refer to the logbook -- I believe  
13 it's Exhibit 7 -- and the dates May 3 and May 4,  
14 1963 in that book. Do you find the name Polis?

15 A I do, on the date 5-3-63.

16 Q And do you also find it on the date 5-4-63?

17 MR. ANDERSON: I object. This is  
18 hearsay; the document speaks for itself. It's  
19 immaterial what he finds on that page.

20 A Polis' name does not appear on 5-4.

21 Q I now show you Exhibit 15-1, which bears the  
22 designation "D<sup>2</sup>p." Does your referring to the  
23 logbook help refresh your recollection as to whose  
24 initials are indicated there?

1 MR. ANDERSON: I object to the question.  
2 It's speculative, irrelevant, immaterial, lacking  
3 in a foundation.

4 A I recognize the name Polis; I know him quite  
5 well as one of the users who did use the machine  
6 a large amount of time. I do not specifically  
7 recall that this typed "D<sup>2</sup>P" note was used. I  
8 see it today. I've seen other students use the  
9 same type of notation for their initials.

10 MR. WELSH: I'd like to ask the Reporter  
11 to mark the tape box as Exhibit 17.

12 Q I might ask: may we also keep this?

13 A Thank you. Yes.

14 Q Thank you. Subject to agreement to return it,  
15 of course.

16 A I don't want to be in the position of volunteering;  
17 but I found in my case that at some time yesterday  
18 these two tapes had been stuffed back in, out of  
19 the box, or they fell out of the box. They're  
20 something -- everything that I originally had  
21 was contained in that box. Apparently they were  
22 in the bottom of the bag yesterday, and were  
23 never produced.

24 Q If I may refresh your recollection, at the end of

1 the deposition yesterday I took the tapes which  
2 had been marked as exhibits.

3 A Yes.

4 Q Do you recall my asking you to retain the other  
5 two that had not been marked as exhibits?

6 A I vaguely recollect. I didn't have a clear  
7 recollection.

8 Q Are the two tapes which you have just produced  
9 the ones that you remember having in the box?

10 A Indeed. Everything that I brought over was  
11 contained in that box.

12 [Cardboard box containing  
13 punched paper tapes, marked  
14 MIT Deposition Exhibit No.  
17 for identification.]

15 Q When you just said "that box," did you mean the  
16 box which has been marked Exhibit 17?

17 A I did mean the box, Exhibit 17.

18 MR. WELSH: I would now like to ask the  
19 Reporter to mark these two additional tapes which  
20 Mr. McKenzie just produced as Exhibits 18 and 19.

21 [Punched paper tape designated  
22 "David Gross - Space War with  
23 knobs and buttons 4/6/64,"  
24 marked MIT Deposition Exhibit  
No. 18 for identification.]

[Punched paper tape designated "Space War/m buttons and knobs 4G," marked MIT Deposition Exhibit No. 19 for identification.]

Q I now hand you what has been marked as Exhibit 18 and ask you if you can identify that, please.

MR. ANDERSON: I object to the question as lacking in a foundation; hearsay as to this witness; unauthenticated exhibits.

A Written on the facing fanfold is the notation "Field punchout David Gross - Space War with Knobs and Buttons 4/6/64" and a large B; a note that that's a binary tape.

Q Who was David Gross?

A David Gross was a student; the same era and association as some of the names I mentioned yesterday, specifically Alan Kotok, Robert Saunders, Peter Samson. I think I mentioned their previous affiliation with the Model Railroad Club. He was one of that group. A somewhat quieter boy; I think that's why his name didn't come to mind when I listed them yesterday.

Q Do you recognize the lettering or handwriting?

A No.

Q Does that tape have an English title in the

1 leader?

2 A Yes. The title "Punch Space War" -- this time  
3 one word -- "P.Q. less than D. Gross greater  
4 than 8 April '64." "April" is abbreviated.

5 Q Do you know what the letters "PQ" meant?

6 A No. There is no standard meaning there. Must  
7 have meant something personal.

8 Q Do you recall how that tape came into your  
9 possession?

10 A This tape, Exhibit 18, was one of the group of  
11 tapes that I collected and stored in the box  
12 labeled Exhibit 17.

13 Q I now hand you Exhibit 19 and ask you if you  
14 could identify that, please.

15 MR. ANDERSON: I object on the same  
16 grounds as my objection with respect to all of  
17 these tapes. They're unauthenticated, hearsay  
18 as to this witness, unproven as to genuineness;  
19 and his testimony is speculation.

20 A The facing fanfold has written -- two words this  
21 time -- "Space War/" and a small "m," "buttons  
22 and knobs 4G." This means "4 go." That is  
23 where we used to enter the program to start it.

24 Also on here, in pencil, is the number

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1 2330.

2 Q Does the number 2330 mean anything to you?

3 A No.

4 I should have said, I distinguish the  
5 number which is in pencil. Everything I previously  
6 read was in ink.

7 Q Does the term "Space War knobs and buttons" on  
8 Exhibit 18 have any meaning to you?

9 A Yes, it does. We had implemented a new input to  
10 the computer, namely a panel with 18 switches,  
11 18 buttons. I distinguish between switches and  
12 buttons. They were all a lever handle switch.  
13 What I term a switch was a locking device. A  
14 button was a spring return lever. And four knobs.  
15 The reference here is that that was utilized as  
16 the control panel for the user to control the  
17 action of the spaceship.

18 Q Were there also control boxes used in conjunction  
19 with that?

20 A I testified --

21 MR. ANDERSON: I object to the question  
22 for lack of a foundation. The witness has  
23 indicated he didn't write the material on the  
24 tape. You've established no foundation for his

1 knowledge with respect to this tape.

2 A I testified yesterday with respect to the  
3 instruction IOT 11 that that was installed in  
4 connection with providing an input to the control  
5 panel that the students built, namely, two control  
6 panels. That preceded this time. The implementa-  
7 tion of the IOT 11 was before the knobs and  
8 buttons, which we had provided.

9 Q Do you recall when the knobs and buttons were  
10 provided by you?

11 A Middle of 1960. Couldn't pin it down very close.

12 Q Middle of when?

13 A Middle Sixties; I'm sorry. Not middle 1960.  
14 Middle Sixties is what I meant.

15 Q Before 1966?

16 MR. ANDERSON: I object. You're leading  
17 the witness.

18 A I could not say for sure.

19 Q Exhibit 18 said "Space War knobs and buttons."  
20 Exhibit 19 said "Space War/m buttons and knobs."

21 Does the term "buttons and knobs" have  
22 any meaning to you?

23 MR. ANDERSON: I object to the question;  
24 grossly improper. It asks this witness what

1 hearsay entries on documents mean to him. It's  
2 immaterial, irrelevant, lacking in a foundation,  
3 hearsay.

4 A I thought that I just testified towards the  
5 question about the control panel which we had  
6 provided with the knobs and buttons and switches.

7 Q So "knobs and buttons" is the same as "buttons  
8 and knobs"?

9 A Certainly.

10 Q I hand you now Exhibit 13, from which you read  
11 the legends appearing on there. Do you know what  
12 the numbers 1, 2, 3, 5, 6 mean on there?

13 MR. ANDERSON: I'll just indicate the  
14 same objections, without repeating them all.

15 A Yes. We have six sense switches on the front  
16 panel. Would it be worthwhile to point to those?

17 Q Yes; if you would, please.

18 A Referring again to Exhibit 10, the PDP-1 handbook,  
19 Page 10, PDP-1 control panel, about the middle of  
20 the right-hand side, you will see the six sense --  
21 this is meant for user interaction with the  
22 program. They are sensed under program controls;  
23 better way to say it.

24 Q That's sense, s-e-n-s-e?

1 A Yes.

2 Q How do you know those are what are referred to  
3 on Exhibit 13?

4 MR. ANDERSON: Objection; same as before.

5 A They were used at that time.

6 Q For playing Space War?

7 A Yes.

8 Q Go ahead.

9 A At that time, we did not have a time-sharing  
10 system; and no other panel -- remember, I  
11 testified that the first versions utilized the  
12 test word. The user was sitting at the console  
13 as apart from later periods, when they were  
14 sitting with the student-constructed control boxes  
15 and later the knobs, buttons, switches panel  
16 which we provided.

17 Q Are the control boxes still present in the RLE?

18 A They're not present in the RLE.

19 Interestingly enough, I heard within  
20 the past couple of months that they are still  
21 over at the Artificial Intelligence Laboratory.  
22 That would be Tech Square; a group that was  
23 originally part of Project MAC, but now has  
24 independent funding and status. It was quite a

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1 tie-in between the student hackers, I think --  
2 did we use that term yesterday?

3 Q No; I don't believe the term "hackers" did come  
4 up.

5 A May I withdraw it for now, then; rather than  
6 explain it?

7 Q Well, I'd like -- go ahead.

8 A I'll wait for your question.

9 Q You just used the term "hacker." Would you tell  
10 us what you meant by that term?

11 A Yes. The fellows who almost, it seemed, their  
12 chief interest in life at that period of time was  
13 using great large amounts of computer time. By  
14 that I mean all-night sessions, weekend sessions;  
15 which could last around the clock in some cases.  
16 And I like the term "hacker." Other places,  
17 they've been called computer freaks. I prefer to  
18 retain the "hacker."

19 Some of the same types were associated  
20 with the Artificial Intelligence group; and there  
21 was a great deal of interchange. Some of the  
22 games that they worked with were -- not games  
23 they worked with; some of their -- yes; things  
24 that they generated were never done for academic

1 credit or for any reason in mind other than, well,  
2 a simple hack -- although it may not have been  
3 simple as it was implemented.

4 Q When you say they had all-night sessions, are  
5 such sessions reflected in the logbooks, Exhibits  
6 4 through 7?

7 A Oh, yes. I guarantee you that you will see that.

8 Q So far as you know, what do the time entries in  
9 these logbooks, Exhibits 4 through 7, mean?

10 MR. ANDERSON: I object; hearsay.

11 A I testified yesterday that we worked on a 24-hour  
12 clock. Midnight is 2400, and time starts again  
13 at zero time after midnight.

14 Q Do the times entered there actually, so far as  
15 you know, reflect the times when the computer was  
16 in use?

17 MR. ANDERSON: I object; hearsay.

18 A Yes. Directly above the console, where the log  
19 is kept, there is a 24-hour clock on the wall.  
20 You'll notice the time is kept accurate within  
21 a minute. Most cases, it's not rounded off by  
22 minutes or anything like that.

23 Q And did you observe students entering the actual  
24 time that was indicated on the clock in the book?

1 A Yes, they do.

2 Q That was the instruction given to them, was it not?

3 A Yes.

4 MR. ANDERSON: I object to the leading  
5 of the witness.

6 Q Was that a custom, to do that?

7 A Yes.

8 MR. ANDERSON: Object to the leading of  
9 the witness.

10 A It was not pertinent at this time; because the  
11 PDP-1 was, quote, going along for a ride. But  
12 later on, when we had a great deal of activity  
13 on it, I had to issue quarterly usage reports;  
14 and I scanned the log and compiled monthly  
15 utilization determining the affiliation of the  
16 user. That is, was he working with a sponsored  
17 research group? If he was, then I would tie him  
18 down to the professor in charge of the project.  
19 Was he strictly on a hack? I've used the term  
20 "strictly hacking." Then it would be an EE  
21 Department charge. If it was formal course  
22 activity, it would be an EE Department charge.

23 And based on this, we were able to  
24 justify, sometimes, capital equipment charges.

1 If not capital equipment, at least day-to-day  
2 charges; paper, supplies. Since we do fund from  
3 three sources, it was necessary to do this. It  
4 was not kept in a formal enough fashion that time  
5 could be allocated to a project. A government  
6 auditor would not accept it. But it was accepted  
7 in-house.

8 Q You say that occurred later?

9 A It's done to this day. But it was not necessary  
10 on the PDP-1 at this time, because there was not  
11 really any formal activity on it. We were still  
12 heavily involved with -- I might say, at this  
13 time, by "this time" I mean the first year. If  
14 we're talking later about 1964 dates, we've seen  
15 it was important at that time.

16 Q Did it also include the 1963 dates in these logs?

17 A Yes. I'm sure there was activity at that time  
18 that I would want to account for. We did have  
19 course activity starting in September of '62.

20 Q You referred to the Artificial Intelligence Lab.  
21 What is artificial intelligence?

22 MR. ANDERSON: I object for lack of a  
23 foundation.

24 Q Do you know what artificial intelligence is, as

1 used in that phrase, "Artificial Intelligence  
2 Lab"?

3 A Let me explain it by saying the typical type of  
4 activity they do. They're working with robotic  
5 control there. This is not only sensors, that  
6 form of touch; but also visual sense.

7 Q And was voice included?

8 A If it was included, it was not their specialty.  
9 There are other labs that are more interested in  
10 voice. They could have been in that, but it was  
11 not their field.

12 By "voice," I think I'd like to classify  
13 as the term "speech." There is a speech group.

14 Q There is now?

15 A There was, dating back to '59 at least, on the  
16 TX-0; and that same group under Professor Ken  
17 Stevens exists today.

18 Q Did the speech group also use the PDP-1?

19 A Yes, they did.

20 Q Do you recall any of the students in the speech  
21 group?

22 A The first name that comes to mind is Raymond  
23 Tomlinson.

24 Q Any others?

1 A No. His activities so far outshined the others  
2 that at this point I . . .

3 Q Did the speech group deal with voice synthesization?

4 MR. ANDERSON: I object to leading the  
5 witness.

6 A Their first work on the TX-0 was looking as to  
7 how do you characterize speech. If I can go back,  
8 I mentioned the first name that came readily to  
9 mind was Raymond Tomlinson. He did a master's  
10 thesis using the PDP-1 to control his speech  
11 synthesizer; which had the name Spass, S-p-a-s-s.  
12 The output from that -- well, sometimes when we  
13 hear what we think of as speech from a computer,  
14 it's something that has been fed into the computer  
15 from a magnetic tape, possibly an analog -- most  
16 likely in analog form, and converted to digital,  
17 processed in the computer, and sort of filtering  
18 and brought back from digital to analog and played  
19 through a speaker, earphones.

20 In Tomlinson's case, the speech did not  
21 originate in that fashion. He actually typed in  
22 the specifications for the speech. I clearly  
23 remember the output was the sentence "Are you a  
24 good boy or a bad boy?" And by changing the

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1 specification, he could change the inflection  
2 and make it sound like a man's voice, something  
3 hoarse.

4 Q Were there speakers connected to the computer for  
5 that purpose?

6 A Yes. Among other things, we've had stereo,  
7 music, on the computer. Speakers were there.  
8 Although I think in his case he probably had a --  
9 he had a six-foot rack of equipment; and probably  
10 in his case the speaker would have been part of  
11 his equipment, because he was driving the speaker  
12 from his setup, I'm sure.

13 Q Was there a PDP-1 at the AI Lab?

14 A Yes. They did have. They had one. Whether they  
15 still have it, I do not know.

16 Q Do you know whether Space War was played on that?

17 MR. ANDERSON: I object for lack of a  
18 foundation, hearsay, speculation.

19 A I was never personally there when it was played.  
20 Knowing the way the students operate, I'm sure  
21 that it was played. This is evidenced by the  
22 fact that they now have the control panel -- not  
23 control panel; control boxes over there. And  
24 remember that the first versions we talked about

1 could have been played on any PDP-1 utilizing the  
2 front panel control switches. It wasn't necessary  
3 to have any special modification, or particular  
4 modification.

5 Q Do you know when the PDP-1 was acquired at the  
6 AI Lab?

7 A Something possibly in the order of a year after  
8 ours. I couldn't pin it down better than that.

9 Prior to that time, Professor Minsky's  
10 group -- Professor Minsky at that time was head  
11 of that group -- they shared our machine. It was  
12 before they moved to Tech Square, where Project  
13 MAC is currently located. I believe their  
14 machine when first received was located on the  
15 first floor of Building 26.

16 Q Do you know where Mr. Tomlinson is today?

17 A Yes. He's currently working at Bolt, Beranek and  
18 Newman in Cambridge, Mass.

19 Q I believe you mentioned them yesterday.

20 A Yes, I'm sure I did.

21 Q That is, as having Serial No. 2, PDP-1?

22 A Yes. Yes. I'm thinking of the prototype as  
23 being 1 and -- I don't know that theirs carries  
24 the distinction 2. I know that DEC kept the

1 first one in-house. The second one they  
2 constructed went to BB&N. Our prints, indeed,  
3 say 3.

4 Q When you first obtained the PDP-1 at RLE, did  
5 you exchange information with BB&N?

6 A Yes.

7 MR. ANDERSON: I object to leading the  
8 witness.

9 Q Excuse me?

10 A I have information here that would show that.

11 Q Okay. Would you produce it, please.

12 A Well, it was demonstrated yesterday in the  
13 listing that we talked about, specifically  
14 talking towards the multiply subroutine; and it  
15 says that, it states in the comment that Page 4,  
16 the comment "BB&N multiply subroutine." Well,  
17 we had good liaison with BB&N. Some of the  
18 people here, factory people, were doing  
19 consulting -- I guess you might call it -- with  
20 them. But beyond that, the DEC User Society was  
21 formed for the very purpose of exchanging  
22 programs.

23 Q I believe you stated you had some other  
24 documentation indicating interchange with BB&N.

1 A Well, not necessarily BB&N; but to show the  
2 interchange of programs between PDP-1 users. This  
3 was somewhat later in time, when there were more  
4 PDP-1 -- not PDP-1; PDP-X, in existence. But  
5 they did publish a list of programs that were  
6 available from a central library maintained by  
7 DEC; and any of the users could requisition a  
8 copy of any of these tapes.

9 So that whether it was formally set up,  
10 in time this was done; but shortly after it, if  
11 not at that time, shortly afterwards on a more  
12 formal basis.

13 Q By "that time," do you mean the time indicated on  
14 Exhibit 9-1-A?

15 A Yes. Yes. I think maybe I have a reference that--  
16 yes; indeed it was active in -- I see I have a  
17 copy of a DEC User Society newsletter called  
18 DECUSCOPE; and the subtitles, "Information for  
19 Digital Equipment Computer Users." This is  
20 Volume 1, No. 2, May 1962.

21 Q Does that contain any reference to Space War?

22 A Yes, it does.

23 I'm sorry; may I backtrack a little  
24 bit? I had one copy within another one. I should

1 have referenced the same heading, only Volume 1,  
2 No. 1, April 1962. Page 2, there is a full  
3 column with the heading "PDP-1 Plays at Space War,"  
4 by D. J. Edwards, MIT and J. M. Graetz, MIT.

5 Q Does that describe a program available through --

6 MR. ANDERSON: I object to the question  
7 as leading.

8 A No. This is a description of the game. The  
9 editor had visited the MIT computer in Room 26-265  
10 and explains somewhat what was seen, how the  
11 game was played, the impression.

12 MR. ANDERSON: May I see it, please?

13 THE WITNESS: Yes.

14 MR. WELSH: May we mark these documents  
15 with the same understanding that we had regarding  
16 the other documents?

17 THE WITNESS: Yes.

18 MR. SMITH: Yes.

19 MR. WELSH: I'd like to ask the Reporter  
20 to mark this DECUSCOPE, Volume 1, No. 1 of April  
21 1962, as Exhibit 20.

22 [DECUSCOPE dated April 1962,  
23 marked MIT Deposition Exhibit  
24 No. 20 for identification.]

Q Mr. McKenzie, where did you obtain Exhibit 20 to

1 bring in for this deposition?

2 A From my file. I'm a DECUS member.

3 Q Do you recall when you obtained Exhibit 20?

4 A It would have been mailed out at the time. I get  
5 every communication.

6 Q Did you, then, obtain it at that time?

7 A Oh, yes. It would have been directed to me  
8 personally.

9 Q Do you recall anyone from DECUS visiting the  
10 PDP-1 facility to obtain information for that  
11 article?

12 A I was not personally involved. If indeed I was  
13 there, it would have been my policy to turn them  
14 over to the students. It was considered a  
15 student activity; and I would not have tried to  
16 participate in any way.

17 Q Have you read the article recently?

18 A Yes, I have.

19 Q Does it accurately reflect your recollection of  
20 Space War as it existed at that time?

21 MR. ANDERSON: I object; hearsay.

22 A Yes, it does.

23 Q You stated that they maintain a library of tapes.  
24 Who did you mean by "they"?

1 A DECUS; DEC User Society.

2 Q Do you know whether they ever had a Space War  
3 tape available?

4 A Yes, they did.

5 Q How do you know that?

6 A The thing that led me into this search was that  
7 I recalled sometime after we had Space War, in  
8 one of the computer meetings in Boston, could  
9 have been in the spring, the spring joint  
10 computer conference at that time was still being,  
11 sometimes, held in Boston; and also in the fall  
12 there was what was called the NERIM exhibit,  
13 NERIM show. In connection with these shows,  
14 there is always a trade exhibit. DEC has always  
15 participated. And at one of these, surprisingly  
16 shortly -- I don't know what "shortly" means;  
17 one or two years -- but anyway, we were surprised  
18 to learn that they had a Space War going in one  
19 of their computers. "Shortly" may not be -- it  
20 may be two years or more. But, you know, it was  
21 not too long afterwards.

22 Q Was it within three years afterwards?

23 A Oh, yes. Whether it was introducing the next  
24 series and so, I'm not sure.

1 Q That is, within three years after Space War  
2 started?

3 A Yes.

4 Q At the PDP-1 facility?

5 A Yes. I tried to find reference as to whether it  
6 was actually available in the library. I didn't  
7 find that the PDP-1 version was available for  
8 distribution. I did find that -- DEC had brought  
9 out a series of computers, the LINC computer,  
10 which was a specialized version of one of their  
11 other series; and under the heading "Games" --

12 MR. ANDERSON: May we know what  
13 document the witness is looking at?

14 THE WITNESS: Yes. It's a DECUS  
15 program library catalog.

16 MR. ANDERSON: Does it have a date?

17 THE WITNESS: On the inside cover, it  
18 carried the date November 1969.

19 And on Page 28G, DECUS L/39, Space War.  
20 This time it's spelled "SPCWAR." Anonymous,  
21 modifications by E. Duffin, University of  
22 Pennsylvania, Philadelphia, Pennsylvania.

23 "Space War" -- spelled as I spelled it  
24 earlier -- "is a game program that permits two

1 users to pilot individual spaceships that are  
2 displayed on the screen. Each pilot has control  
3 of a cannon that enables him to destroy his  
4 opponent's ship. Collisions destroy both  
5 vehicles. Source language: LAP6. Storage  
6 requirement: Memory banks 1, 2, 3."

7 MR. WELSH: Could we have that marked  
8 as Exhibit 21.

9 [DECUS program library  
10 catalog dated November 1969,  
11 marked MIT Deposition  
Exhibit No. 21 for identi-  
fication.]

12 Q With respect to the entry of Exhibit 21 which  
13 you have just read, you indicated that it  
14 involved a LINC computer?

15 A Yes.

16 Q Does that, or did that, have any other  
17 identification?

18 A No. It was carried as a trade name. The  
19 association LINC was a commercial implementation  
20 of a computer developed at Lincoln Laboratory.

21 Q How is LINC spelled?

22 A L-I-N-C.

23 Q And was that a product of DEC, that you know of?

24 A Yes.

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1 Q Did it have any PDP designation?

2 A It was a sub version of one of the other PDP's.

3 Q Do you know which one?

4 A I'm not sure. I had no, I have never had access  
5 to one. Had no need to know it.

6 Q Do you know when the LINC computer was first  
7 offered for sale by DEC?

8 MR. ANDERSON: I object; lack of a  
9 foundation. You've established no knowledge of  
10 this witness with respect to sales by DEC.

11 A One of the interesting things on the DEC, LINC  
12 computer was the DEC tapes, which had also been  
13 developed at Lincoln Laboratory. This computer  
14 was sort of specialized, pointed towards  
15 laboratory-type activity, where you have data in  
16 analog form read into the computer and you make --  
17 you might want to process it or read it in digital  
18 form and do further processing. It lent itself  
19 towards a rather specialized activity, though it  
20 was indeed a general-purpose computer, but did  
21 one thing rather well. Well, you could buy the  
22 whole thing without having to do a lot of add-ons.

23 Q How did you become familiar with the computer?

24 A I had no association with it. One of the groups

1 in RLE, the Communications Biophysics Laboratory,  
2 did have one. I never maintained it or anything,  
3 did any work on it.

4 Q Where did you obtain Exhibit 21 to bring it to  
5 this deposition?

6 A That was in one of my file cabinets.

7 Q Do you know when -- or do you recall receiving  
8 this catalog?

9 A I probably did not personally receive that.  
10 There are two categories of DECUS users. Each  
11 installation is allowed one or two delegates;  
12 and the others, I guess, I'm not sure of any --  
13 well, I'm more or less a general member. But at  
14 one point, Professor Jack Dennis would have been  
15 the delegate; and something of that nature would  
16 have been directed to him. At a later time,  
17 Robert Saunders, when he graduated and received  
18 his bachelor's degree, worked with us for about  
19 a year. During that interval, he was delegated.  
20 Exhibit 21 would more likely have been directed  
21 towards them. I know I don't currently receive  
22 them all the time.

23 Q You say you're a general member?

24 A As differentiating from the delegate, who has a

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1 somewhat higher status. Limited number of  
2 delegates.

3 Q Were meetings held of DECUS members?

4 A Yes.

5 Q Are they still held?

6 A Yes.

7 Q How long have you been a member of DECUS?

8 A I'm a charter member.

9 Q And maybe you said this: when was DECUS formed?

10 A Early in 1962.

11 Q Was it in existence as of April 1962, the date of  
12 Exhibit 20?

13 A Yes, I'd say.

14 Q Are meetings of members of DECUS held on a regular  
15 basis?

16 A Usually twice a year.

17 Q Where are they held?

18 A Right now they could be anywhere in the country.

19 It's not uncommon to have them, maybe, one on  
20 the West Coast and one on the East Coast. There  
21 is also a European organization; maybe more. I  
22 have not been particularly active.

23 Q Are they attended by both types of members?

24 A Yes.

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1 MR. ANDERSON: I object. You haven't  
2 established the witness has any knowledge.

3 A Yes. I have attended meetings here, certainly.  
4 If it's MIT or locally, I would attend. We have  
5 had meetings at MIT.

6 Q Do you know the purpose of those meetings?

7 A Yes; to exchange information.

8 Q Information about what?

9 A Relating to computer usage, exchange of programs,  
10 the types of activities being done on the various  
11 computers.

12 Q Those are computers of Digital Equipment  
13 Corporation?

14 A Yes, that's correct.

15 Q Do you recall when you attended meetings of DECUS?

16 A There was one held at MIT, in the Kresge  
17 Auditorium; and Natalio Kerlenevitch gave a paper  
18 about our time-sharing system, which was in the  
19 process of being implemented, sometime in '63,  
20 '64. I couldn't tie it down.

21 Q Did you bring any other -- oh, strike that.

22 I notice that a portion of the front  
23 cover page of Exhibit 21 has been, apparently,  
24 cut out. Do you know how that occurred?

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1 A I cannot account for that. As I testified, I  
2 don't believe that it was directed to me  
3 personally.

4 [Recess.]

5 Q Referring to Page 24E and the lower right corner  
6 of that page, is there a program described there?

7 MR. ANDERSON: I object. The document  
8 speaks for itself.

9 A There is a program numbered DECUS No. 7-40,  
10 entitled "Duel," N. S. Peterson and J. C. Viner,  
11 University Mathematical Laboratory, Cambridge  
12 University, England.

13 Short description: "Duel is a game  
14 played by two people using the PDP-7 and 340  
15 display. Each person operates five switches  
16 which control the moving and gunfiring of his  
17 own 'spaceship' on the display screen. The object  
18 is to destroy the enemy ship by the firing of  
19 bullets.

20 "Minimum hardware: PDP-7 with 340  
21 display."

22 Q Have you ever heard of that game, Duel?

23 A Not that title.

24 Q Under any other title?

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1 MR. ANDERSON: I object.

2 A Sounds very much like Space War.

3 Q Did you bring any other documents from DECUS?

4 A Yes. Trying to fill the requirements of the  
5 attachment, which incidentally bothered me  
6 greatly -- I knew that I couldn't begin, the  
7 interpretation, I couldn't begin to fill it.  
8 As a matter of fact, I protested to Mr. Smith's  
9 office -- directly, I think, to Mr. Robert Shaw.  
10 And so I attempted to bring representative  
11 material; and one of the things named was  
12 periodicals.

13 The other thing that I say, we searched  
14 into this, really, looking for references to  
15 Space War being played on a DEC machine; and I  
16 instantly spotted something that brought back  
17 my mind, what I thought would be a pertinent  
18 article. In the volume of DECUSCOPE carrying  
19 the same earlier-mentioned subtitle, Volume 1,  
20 No. 2, May 1962, in the left-hand column of the  
21 first page is the heading "DECUS Technical Meeting  
22 Program, May 17, 1962, ITEK Corporation, 10  
23 Maguire Road, Lexington, Mass."

24 If I may skip the morning session,

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1 "Afternoon Session (1:30 - 4:00) PDP-1 scope  
2 displays, J. M. Graetz, MIT." It's continued on  
3 Page 3. The continuation is a series of articles;  
4 the next article, "Tripos Display, Dan Edwards,  
5 MIT"; and a continuing list of papers.

6 Q I believe you selected that -- as you stated, you  
7 selected it as relating to Space War. How does  
8 that program you mentioned relate to Space War?

9 A The DEC User Society published proceedings annually  
10 which carried copies of all the articles presented  
11 at the meetings held during the year. I believe  
12 I earlier testified that there would have been a  
13 spring and fall session. And I looked for the  
14 paper on scope displays given by J. M. Graetz.

15 MR. WELSH: First, could we have this  
16 DECUSCOPE, Volume 1, No. 2 of May 1962 marked as  
17 Exhibit 22, please.

18 [DECUSCOPE dated May 1962,  
19 marked MIT Deposition  
20 Exhibit No. 22 for identi-  
fication.]

21 Q Excuse me. Now, you were referring to DECUS  
22 publishing papers presented at meetings?

23 A Yes. I have before me DECUS Proceedings 1962;  
24 papers and presentations of the Digital Equipment

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1 Computer User Society, Maynard, Massachusetts.

2 MR. WELSH: Excuse me. Could we have  
3 this marked as Exhibit 23, please.

4 [DECUS Proceedings, 1962,  
5 marked MIT Deposition Exhibit  
6 No. 23 for identification.]

7 MR. ANDERSON: May I see it, please?

8 MR. WELSH: Sure.

9 MR. SMITH: Off the record a second.

10 [Discussion off the record.]

11 MR. SMITH: I'd like to go on the  
12 record just to the effect that if in fact there  
13 should be additional tapes or other information  
14 relating to Space War in the filing cabinets in  
15 Mr. McKenzie's office --

16 THE WITNESS: Building 26, Rooms 248  
17 and 260.

18 MR. SMITH: -- that these are in fact  
19 available to be produced either here under this  
20 subpoena if requested, or available for either  
21 party to inspect at any time in the future;  
22 provided we have some notice so we can arrange  
23 to set it up.

24 THE WITNESS: May I also state -- am I  
off the record?

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1 MR. WELSH: You're on.

2 THE WITNESS: Well, the bulk of this  
3 would not be locked up. Most everything I'm  
4 talking about is accessible to the students. In  
5 fact, it is their material, considered as theirs  
6 rather than mine.

7 MR. SMITH: Fine.

8 MR. ANDERSON: We do appreciate the  
9 offer, Mr. Smith; and we may take you up on it,  
10 and will make arrangements to come, and someone  
11 can steer us and leave us to look through the  
12 nine file cabinets, I presume.

13 MR. HERBERT: We may like to do the same  
14 thing; and I don't know how much of a headache it  
15 would be to have two people trooping in at  
16 separate times. Do you think that we should try  
17 to arrange our schedules to show up at the same  
18 time, if more than one is going to look; or would  
19 it make any difference to you?

20 MR. SMITH: Well, certainly it would be  
21 more advantageous from MIT's point of view to have  
22 all of the parties at the same time; because  
23 somebody from my office will be present during  
24 that proceeding, and it would certainly cut down

1 on our time loss.

2 MR. HERBERT: In view of that, Mr.  
3 Anderson, if you propose to come, I'd appreciate  
4 it if you'd get in touch with me.

5 MR. ANDERSON: All right; we'll make  
6 that mutual. If you make any plans, let me know.

7 MR. HERBERT: Right. I assume that --

8 MR. WELSH: In case either of you makes  
9 any plans, would you please let me know also.

10 MR. ANDERSON: All right.

11 MR. SMITH: I would like to say, then,  
12 for the record, that any plans for paying a visit  
13 should be directed through my office. I'll  
14 arrange for it, and I will notify any of the  
15 other parties.

16 MR. WELSH: Thank you very much.

17 Q I now hand you the book which you produced, DECUS  
18 Proceedings 1962, which has been marked as  
19 Exhibit 23; and about which you were testifying  
20 when I interrupted you to mark the exhibit.  
21 Would you now proceed.

22 A Yes. I was interested in finding a copy of the  
23 papers presented at the spring DECUS meeting in  
24 '62 by J. M. Graetz. That article appears on

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1 on our time loss.

2 MR. HERBERT: In view of that, Mr.  
3 Anderson, if you propose to come, I'd appreciate  
4 it if you'd get in touch with me.

5 MR. ANDERSON: All right; we'll make  
6 that mutual. If you make any plans, let me know.

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9 any plans, would you please let me know also.

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12 for the record, that any plans for paying a visit  
13 should be directed through my office. I'll  
14 arrange for it, and I will notify any of the  
15 other parties.

16 MR. WELSH: Thank you very much.

17 Q I now hand you the book which you produced, DECUS  
18 Proceedings 1962, which has been marked as  
19 Exhibit 23; and about which you were testifying  
20 when I interrupted you to mark the exhibit.

21 Would you now proceed.

22 A Yes. I was interested in finding a copy of the  
23 papers presented at the spring DECUS meeting in  
24 '62 by J. M. Graetz. That article appears on

1 Page 37.

2 Q And what is the subject matter of that article?

3 A The title is "Space War. Real-Time Capability  
4 of the PDP-1. J. M. Graetz."

5 There is an abstract. Do you want the  
6 abstract?

7 Q No; that won't be necessary.

8 Where did you obtain Exhibits 22 and 23  
9 in order to bring them to this deposition?

10 A 22 was in my file; and as I have earlier  
11 testified, being a DECUS member, I continue to  
12 receive the monthly newsletter. I'll refer to  
13 this as a newsletter.

14 Q Have you kept all copies of DECUSCOPEs since you  
15 became a member?

16 A Not religiously. I have a great number of them.

17 Q Is there any reason for keeping some of them and  
18 not others?

19 A Well, as the thing started I had lots of space;  
20 and I think it became sort of a space problem  
21 after that. Couldn't carry all these things.

22 Q Do you know when you received Exhibit 22?

23 A The volume is the May volume. I'm not sure  
24 whether they come on the following month or not.

1 I think oftentimes they are somewhat delayed.  
2 But it would have been about that time. How  
3 their schedule was at that time, I don't know;  
4 but there was an effort to publish one every  
5 month, and somehow I had a feeling that they  
6 weren't always published at specific dates.

7 Q Is that May 1962?

8 A Well, I think that's generally been true. Some  
9 of the things I get from them now, I might get  
10 two months within a week -- things pertaining to  
11 the PDP-11, for instance.

12 Q Does the year 1962 appear on Exhibit 22?

13 A Yes. The date is May 1962.

14 Q Did you receive this on or about that time?

15 A Yes.

16 Q And did you place it in your personal file?

17 A Not personal file. One of the many files in the  
18 room, one of the many file cases in the room.  
19 The place I found it was not locked.

20 Q Was it a file maintained by you?

21 A Yes, but not in terribly good shape. Many years  
22 now, I've had no secretary. Low-budget operation.  
23 So I just keep stuffing things in the back.

24 Q Did you place the exhibit in your file?

1 A I'm sure I did.

2 Q Did you consider it to be a personal file or a  
3 file of the Institute?

4 MR. ANDERSON: I object. I think the  
5 question has been answered.

6 A I would consider everything in the room would  
7 belong to the Institute.

8 Q Were you a member of DECUS individually or as an  
9 employee of the Institute?

10 A As an employee. I'm sure I carried my  
11 affiliation. I was not an individual member.  
12 My distinction was to differentiate between the  
13 higher-level delegate, who had I think additional  
14 voting power, and the more, the wider distributed  
15 regular memberships.

16 Q Referring now to Exhibit 23, do you recall where  
17 you obtained that in order to bring it to this  
18 deposition?

19 A Yes. It was found in a file cabinet in Room  
20 26-260.

21 Q Do you know who placed it in the file cabinet?

22 A I do not know. I would suspect that this, along  
23 with the Exhibit 21 that I testified to earlier,  
24 was probably directed to the delegates rather

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1           than to me personally.

2   Q       Exhibit 23 bears the date, I believe, of February --  
3           it contains the title "DECUS Proceedings 1962."  
4           Do you know when that was received in Room 26-260?

5   A       No.

6                       MR. ANDERSON: I object. I think it  
7           lacks a foundation. His testimony indicates he  
8           doesn't even know how it got into the file.

9   A       It was not directed to me personally, I know.

10   Q       Do you recall seeing it and reading the article  
11           by Mr. Graetz appearing in there?

12   A       Yes, I did. I did read it.

13   Q       Did you read it at that time?

14   A       At the time it was received, yes.

15   Q       Was that 1962 or 1963?

16   A       I have no way of knowing.

17   Q       But you do recall it was the time when it was  
18           received in the lab?

19                       MR. ANDERSON: I object. I don't think  
20           that's his testimony.

21   A       I do recall reading the article when it was  
22           first -- it was passed around. The nature of it  
23           made it of common interest to all the people  
24           associated with the machine. It was generally

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1 discussed.

2 Q Have you reread the article recently?

3 A Yes.

4 Q How long ago?

5 A Within the last month.

6 Q Does that article accurately reflect Space War  
7 as you recall it having been played in 1962?

8 MR. ANDERSON: I object; hearsay.

9 A Yes, it does. I consider that it does.

10 Q Turning to Page 39 of Exhibit 23, would you tell  
11 us what is depicted there?

12 A This is a time photo of two spaceships maneuvering  
13 around the heavy star or sun; that is, the one  
14 which we've earlier discussed as having gravity,  
15 or optionally having gravity.

16 Q How did the spaceships appear there?

17 A Well, their trajectory is shown. Since this  
18 photo was taken over a period of time, you can  
19 see their trajectory, that I used earlier, across  
20 the screen.

21 Q Are their trajectories appearing there as curved  
22 paths?

23 A Yes, that's correct. The curving would indicate,  
24 the nature of the curving would indicate, that

1 the gravity option is on at that time; if indeed  
2 this program had the option. They did not all  
3 have that.

4 Q Do other objects than the spaceships and heavy  
5 star or sun appear?

6 A Yes.

7 MR. ANDERSON: I object to this line of  
8 questioning as hearsay. You have not established  
9 any foundation for this line of questioning about  
10 this particular page of Exhibit 23.

11 A In the background, the star field is displayed.

12 Q Does that picture accurately reflect the view on  
13 the CRT display of the PDP-1 computer as you  
14 observed the game back in 1962?

15 MR. ANDERSON: Same objection.

16 A If I may qualify it a little bit, the qualification  
17 would be in the nature of the persistence, depend-  
18 ing on the light in the room, whether indeed you  
19 would see as many -- the spaceship in quite as  
20 many positions. That is, the visual aspect would  
21 not under all conditions be exactly like this.

22 Q Otherwise, does it accurately reflect the game  
23 as you recall observing it?

24 A Yes, certainly.

1 Q Now, you also produced another document bearing  
2 the name "DECUS." Would you tell us what that is,  
3 please?

4 A The front page, "DECUS" and "Digital Equipment  
5 Computer User Society." And I think I had  
6 earlier been questioned, and it was not pursued,  
7 something about the objectives of the Society  
8 and membership; and this does indeed spell out  
9 those two functions. There also is included a  
10 DECUS installation members, a list of the DECUS  
11 installation members. However, I must note that  
12 this is somewhat later in time than everything  
13 we've been talking about. DEC's notation on the  
14 back page is 50-3/65. This would indicate, from  
15 my work with having seen DEC manuals, that it was  
16 published or first made available in March of  
17 1965.

18 MR. WELSH: Would the Reporter please  
19 mark this document as Exhibit 24.

20 [DECUS document dated  
21 March 1965, marked MIT  
22 Deposition Exhibit No. 24  
for identification.]

23 MR. ANDERSON: May I see it?

24 MR. WELSH: Sure.

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1 Q How did you obtain Exhibit 24 in order to bring it  
2 to this deposition?

3 A I found it in one of the file cabinets in one of  
4 my two rooms that I earlier mentioned.

5 Q Do you know when that exhibit was placed in that  
6 file cabinet?

7 A I do not know.

8 Q Do you recall having seen that exhibit before you  
9 took it out of the file cabinet to bring here?

10 A As a DECUS member, I would regularly get that  
11 sort of material.

12 Q And do you recall this particular document?

13 A Nothing special, no.

14 Q I believe the subject of DECUS came up in  
15 connection with a question regarding exchange of  
16 information regarding the PDP-1 with Bolt,  
17 Beranek and Newman.

18 A Yes.

19 Q Did you deal directly with -- I believe you  
20 referred to Bolt, Beranek and Newman as BB&N?

21 A Yes.

22 Q Did you deal directly with them in the exchange  
23 of information?

24 A No. This would have been one of the programmers;

1 the software aspect. From time to time, we have  
2 had users working with them. I'm sure that one  
3 of our students was working there nights. One of  
4 our professors was associated with them at that  
5 time. I would be most certain that that earlier  
6 specified subroutine did not come through a  
7 formal DECUS channel, but through a private  
8 exchange with BB&N.

9 Q Do you know whether Space War was played at BB&N  
10 on the PDP-1 there?

11 A I never witnessed it being played there. It  
12 would have been possible to take one of our  
13 tapes and play it on the BB&N machine.

14 There again, let me qualify: the tape  
15 that utilized the front panel test word switches.

16 Q Did the subroutine referred to on Page 4 of  
17 Exhibit 9-1-A actually come from BB&N, that you  
18 know of?

19 MR. ANDERSON: I object; lack of a  
20 foundation. This document was prepared within  
21 the last few weeks, according to the witness.

22 A The document is a copy of one of the tapes  
23 carrying an early date, 1962. The BB&N subroutine,  
24 as I've stated earlier, would have been a private

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1 communication. The DECUS library would have been  
2 an exchange of programs at a somewhat higher  
3 level than these rather short subroutines. And  
4 our liaison with BB&N was so good that that would  
5 have been an easier, more expeditious channel.

6 Q Do you know whether any tapes of Space War were  
7 finished by users of the PDP-1 at RLE to anyone  
8 outside of RLE at MIT?

9 A Yes, they were.

10 Q To whom were such tapes provided?

11 A I did not personally give any of the tapes. I  
12 did not consider it my program to give away.  
13 Any inquiries of that nature I directed toward  
14 the students involved. It was their judgment;  
15 it was their program.

16 Q And how do you know that they gave tapes to  
17 others?

18 A I've seen them duplicating. I've referenced  
19 inquiries to them.

20 Q Do you know whether any tapes were given or  
21 furnished by them to anyone outside of MIT?

22 A I never witnessed a transaction.

23 Q You said you referred inquiries?

24 A Yes, I did.

1 Q To them. Did you receive any inquiries from  
2 anyone outside of MIT?

3 A Yes.

4 Q And do you recall who that might be?

5 MR. ANDERSON: Object to the  
6 speculative nature of the question.

7 A No. I couldn't, no. I dismissed it as nothing  
8 of my concern. I would have no recollection.

9 Q Are you acquainted with John McCarthy?

10 A Yes, Professor McCarthy.

11 Q How long have you known him?

12 A He had an office on the same floor as my  
13 installation; that is, the second floor of  
14 Building 26. And I'm pretty sure he was in that  
15 area at the time I moved there, the summer of  
16 1958.

17 Q What organization or group did he work with?

18 A At that time, it was RLE.

19 Q Did he have anything to do with the PDP computer  
20 when it was installed at RLE?

21 A Yes. He had great interest in it. I testified  
22 to the fact yesterday that it was in his area  
23 for a while. Some of his people, the earlier  
24 mentioned Daniel Edwards, worked pretty much --

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1 worked under the direction of Professor McCarthy;  
2 and they used time on our PDP-1 until their  
3 machine was delivered.

4 Q And what type of machine was delivered?

5 A They received a PDP-1, DEC PDP-1 computer.

6 Q And when was that?

7 A I cannot say for sure. My best estimate would  
8 be sometime about a year after ours.

9 Q What was the location of that other PDP-1 when  
10 it was delivered?

11 A When it was delivered, it was installed in a  
12 room of the first floor of Building 26.

13 Q What was that facility known as?

14 A They were the Artificial Intelligence group in  
15 RLE.

16 Q The AI group of RLE?

17 A Yes.

18 May I tie it down a little more  
19 explicitly? It was Professor Minsky and  
20 Professor John McCarthy together; Professor  
21 Marvin Minsky.

22 Q Do you know whether Space War was played on that  
23 PDP-1?

24 A I never personally saw it played. I'm sure it

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1 would have been. It was the same fellows  
2 working back and forth between the two machines.

3 Q There was an overlap of users?

4 A Yes.

5 MR. ANDERSON: I object.

6 Q Is Mr. McCarthy or Professor McCarthy still at  
7 MIT?

8 A No. He is currently, or not too long ago was,  
9 at Stanford University.

10 Q When did he leave MIT?

11 A I couldn't say in detail. I didn't work  
12 directly with him. Sometime, my best guess,  
13 putting limits on it, would be between 1965 and  
14 '70; but I must admit that's a guess.

15 Q Do you know where he went when he left?

16 A I believe he went directly to Stanford at that  
17 time; but there again I'm not sure. I had no  
18 direct touch.

19 Q Do you know whether any PDP-1 programs were sent  
20 to him from MIT, sent to him at Stanford from  
21 MIT?

22 A They were not sent by me. I have no knowledge.

23 Q Did you state yesterday that a history of the  
24 use of the TX-0 computer had been prepared?

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1 A Yes.

2 Q Who prepared that history?

3 A I did.

4 Q Did you have any reference materials that you  
5 used to obtain information for the preparation of  
6 that history?

7 A Yes. I read through the logbook used with the  
8 TX-0; went through a collection of theses that  
9 I have, work done on the TX-0; utilized some of  
10 the Lincoln Laboratory memos for the time before  
11 I was directly associated with it; looked at  
12 some private correspondence -- that is, not  
13 private to me, but directed to first Earl Pughe,  
14 first in charge Earl Pughe, second Professor  
15 Jack Dennis. And this was in a correspondence  
16 file with a slot, a folder, for each of the years;  
17 not private in a sense, but personal, but  
18 pertaining to the installation.

19 Q Were the logbooks of the TX-0 kept in the same  
20 manner as the logbooks of the PDP-1, such as  
21 Exhibits 4 through 7?

22 A Yes; though interestingly enough, a lot of them  
23 had been intermixed, and I sorted them out in  
24 sequence.

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1                   For some strange reason, the TX-0 books  
2 ended up in an unlocked cabinet, and the PDP-1  
3 ended up, dictated by no particular reason, in a  
4 cabinet that would be locked, except during  
5 working hours.

6   Q   And when did you find this location of the two  
7 sets of logbooks?

8   A   Well, they were all in my custody; but I don't  
9 think that they were organized any way. Some of  
10 them were intermingled.

11   Q   And what period of time are we talking about now?

12   A   Oh, probably started the history in '72. It's  
13 been updated several times.

14   Q   Does the history contain any -- strike that.

15                   Did the TX-0 have a CRT display?

16   A   Yes, it did.

17   Q   Did the history which you wrote contain any  
18 reference to any games played on a TX-0 and using  
19 the CRT display?

20   A   I know for sure that I referenced the game Mouse,  
21 which is a computer simulation of a mouse  
22 hunting its way through a maze trying to find a  
23 cheese.

24   Q   Did you actually observe that game?

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1 A Oh, yes. It was our standard demonstration  
2 program.

3 Q And when was that game played? During what  
4 period of time was that game played on the TX-0?

5 A If I may restate it, to answer it restating the  
6 fact, at what time it was written -- it was  
7 written by Johnny Ward and Douglas Ross. When  
8 the TX-0 first became operational at MIT campus,  
9 it would be the fall of 1958. The motivation  
10 for writing it was -- well, one reason, for  
11 becoming familiar with the machine; but a second  
12 reason for expediting it was that we planned to  
13 have a dedication ceremony, that is, the  
14 presentation of the machine from Lincoln  
15 Laboratory, and the game was used at that time.  
16 We had a variation of it, a section of the tape  
17 that we substituted cocktails for the cheese;  
18 and strangely enough, there was an anomaly in  
19 the program that if -- well, you had the option  
20 that you could rerun the mouse, the logic of the  
21 program was that the mouse had a history of all  
22 the blind alleys. He did not retrace his steps.  
23 If you tried to rerun it a second time, there  
24 was an anomaly, that the mouse took off and

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1 wrapped itself around the display. I always  
2 utilized that as a demonstration that the mouse  
3 had become somewhat intoxicated.

4 Q You then actually observed the game as it was  
5 played at that time?

6 A I ran that many, many times.

7 Q Could you describe more in detail what was the  
8 appearance of the maze and the movements of the  
9 mouse in the maze?

10 A Yes. Starting out, we had a card that we set up  
11 below a row of switches corresponding to the  
12 test word switches that we've referenced on the  
13 PDP-1. On the TX-0, these switches were labeled  
14 TAC, which was the test accumulator. The left-  
15 most switch was the do switch. When you flicked  
16 or turned on this leftmost switch, the action  
17 that took place was determined by some five,  
18 possibly six -- enumerate them -- conditions of  
19 the right-hand switches. One was to erase walls.  
20 Another would have been to write a wall. Another  
21 would have been "insert mouse." Another would  
22 have been "insert a cheese."

23 The way that these were utilized was,  
24 we had a light pen; and the first section of the

1 tape was read in and a raw maze was displayed  
2 with a series of dots. You pointed your light  
3 pen to one of these control dots. If it was a  
4 dot that was in the middle of a line that you  
5 wanted, and the do switch and the right wall  
6 switch were currently on, a line would appear to  
7 complete that square. The maze was made up of a  
8 series of squares. The mouse was obtained, and  
9 the cheese was spotted in the same manner.

10 Is that sufficient for the question?

11 Q Over what area of the cathode ray tube was the  
12 maze displayed?

13 A The raster, as we talked about yesterday, on the  
14 PDP-1 was somewhat larger than the TX-0. The  
15 TX-0 raster size would be the order of seven by  
16 seven inches.

17 Q And did the maze fill substantially all of that  
18 raster, or less?

19 A Well, with the manual intervention from the  
20 switches, the user had the option of constructing  
21 any type of maze. The maze did not necessarily  
22 fill all of the raster.

23 Q Did the mouse move through the maze after the  
24 maze was, the image --

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1 A When you said "do mouse," the mouse would start  
2 to move.

3 Q Where did it start from?

4 A Normally, you started it in the upper left-hand  
5 corner. It was supposed to be elective; but  
6 there were some, again, anomalies in the program,  
7 and it was more reliable if it was indeed  
8 started in the upper left-hand corner of the maze.

9 Q Was the cheese located, then, somewhere else in  
10 the maze?

11 A There again, that was optional. There was built  
12 into the logic the idea, the concept, that the  
13 mouse had 100 moves. If he did not find the  
14 cheese, to obtain some nourishment, before he  
15 utilized his 100 moves, he became tired; his tail  
16 would stop wagging. At that time, you had the  
17 option of using the light pen, inserting a "do  
18 cheese," inserting the cheese there; and the  
19 mouse would feed.

20 The more interesting aspect was to  
21 rerun him, do mouse a second time. The concept  
22 of memory was involved. The mouse would not go  
23 down a blind alley. Any point that he had  
24 previously retraced his steps, he would take a

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1 more direct path to the cheese; and this time  
2 he would likely find it. If there were three  
3 cheeses, he had 100 steps. If it was only one  
4 cheese in the maze, I think he was allowed 300  
5 steps.

6 Q Once the movement of the mouse began, did the user  
7 of the machine have any control over the mouse?

8 A It was not the intent that there would be any  
9 control. You could certainly stop the computer,  
10 abort the program; but it was not meant as a game  
11 of skill.

12 Q Would you describe the movement of the mouse with  
13 respect to the maze and the cheese after the mouse  
14 started to move?

15 A Yes. The logic of the program was that the mouse  
16 would go ahead -- I'm saying going ahead -- he  
17 started from left to right until he found a wall.  
18 When he found a wall, he would start turning  
19 around and examine the other walls in the area,  
20 and then retrace his steps in the same process,  
21 examining each wall as he retraced his steps.  
22 If he found an opening, he would go through the  
23 opening.

24 MR. WELSH: Could I have that answer

1 back, please?

2 [Answer read.]

3 Q What was the shape of the mouse generally, first?

4 A It was the outline of the way you would draw a  
5 mouse, the way any person would draw a mouse.  
6 It looked realistic.

7 Q Was it elongated?

8 A Not exaggerated. It looked, the proportion was  
9 correct. There was a tail that wagged when there  
10 was motion. There was a nose and the appearance  
11 of two ears.

12 Q What was the relation of the mouse to a wall when  
13 the mouse found the wall, as you used the term  
14 "found"?

15 A The mouse would retract to the center of the  
16 square. The maze was made up of a series of  
17 squares. And the mouse would identify each of  
18 the walls of his current location, and backtrack,  
19 if there was no exit other than the point from  
20 which he had entered that block; and the maze was  
21 a series of square blocks.

22 Q When he found a wall, did his nose appear to  
23 touch the wall?

24 A Yes.

1 Q And then, when he moved it to the center from  
2 that point, did his direction reverse away from  
3 the wall?

4 MR. ANDERSON: I object. You're  
5 leading the witness.

6 A Yes. I couldn't tell whether it was a clockwise  
7 or counterclockwise. I'm sure, rather certain,  
8 it was counterclockwise rotation.

9 Q Did it rotate from the position where the nose  
10 appeared to contact the wall, or did it move back  
11 away from that and then rotate?

12 A It was more nearly the center of the square.

13 Q Did it move from the wall back to the center?

14 A Yes. It backed up, and then examined each of  
15 the remaining walls.

16 Q What constituted a move, or a step? I believe  
17 you said there were 100 moves if there were one  
18 piece of cheese, or 100 steps. What constituted,  
19 in the movement that you've just described, one  
20 step?

21 A I can't say exactly. I cannot state very  
22 specifically. I can estimate, but I couldn't  
23 give a specific answer.

24 Q Well, do you have any idea?

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1 A The ballpark figure was that each of the sensings  
2 of the walls was a step; and it took in the order  
3 of three progressions to get across a square,  
4 ballpark figure.

5 Q Did any of the theses which you used as reference  
6 material for writing your history of the TX-0  
7 relate to the Mouse game?

8 A No. Both the gentlemen earlier mentioned, John  
9 Ward and Douglas Ross, were DSR staff members.

10 Q Are you contemplating writing a history of the  
11 PDP-1 similar to the history which you have  
12 written of the TX-0?

13 MR. ANDERSON: I object. The question  
14 has been asked and answered.

15 A I expect I'll be asked to. It's going to be  
16 time-consuming. I'm not sure when I'm going to  
17 find time. Somebody should do it. I hope  
18 possibly I can get some assistance; some of the  
19 hackers who are now in the area volunteered some.

20 Q Do you have any plan to write such a history?

21 A It is my hope to write such a history.

22 Q Have you done any work toward that end thus far?

23 A No.

24 Q Have you determined what reference material you

1 might refer to in preparing that history?

2 A The first thing that I'd look at would be to go  
3 through the logbooks of the PDP-1 computer.

4 Q Now, you've recently read some of those logbooks,  
5 specifically Exhibits 4 through 7; is that  
6 correct?

7 A Yes.

8 Q Do those entries in the logbooks accurately  
9 reflect your recollection of what occurred with  
10 respect to the PDP-1 during the times represented  
11 by the books?

12 MR. ANDERSON: I object. It's  
13 speculative, hearsay, an improper question.

14 A Certainly all of the pertinent information was  
15 included; and we have received excellent  
16 cooperation from the users entering their names.

17 I think I testified earlier, or  
18 yesterday, that the only problem we might have  
19 had would be when we had a large number, a class,  
20 in there; and users might not always individually  
21 register.

22 Q When you reread the entries in these logbooks in  
23 preparation for this deposition, was your  
24 recollection refreshed with respect to what

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1 occurred on the dates indicated in the entries?

2 A Certainly helpful.

3 Q And based on that refreshing of your recollection,  
4 do these entries accurately reflect what occurred  
5 with respect to the PDP-1 during the dates  
6 indicated?

7 MR. ANDERSON: Same objection; hearsay,  
8 speculation, conclusion, opinion.

9 A The computer logbooks are always a good  
10 reflection of the activity on the machine.

11 Q And is it an accurate reflection, so far as you  
12 know?

13 MR. ANDERSON: Objection. The question  
14 has been asked and answered, and objected to,  
15 several times.

16 A It certainly is not a hundred percent accurate.  
17 It's very good, though.

18 Q Who owns these exhibits, 4 through 7, the PDP  
19 logbooks?

20 A They're in my personal custody. I would consider  
21 that they are MIT material.

22 Q Now, you stated that students were users of the  
23 PDP-1. Were MIT faculty members also users?

24 A Yes. Professor McCarthy, Professor Minsky,

1 earlier referenced; Professor Jack Dennis, earlier  
2 mentioned.

3 Q The PDP-1 itself was the property of the  
4 Institute, was it not?

5 A It was a gift to the Electrical Engineering  
6 Department of MIT. However, as things were  
7 added on, the funding broke off to RLE,  
8 Electronics Systems Lab.

9 Q But those were still departments of MIT?

10 A Yes; and still under the broader title Electrical  
11 Engineering Department.

12 Q Were other persons affiliated with MIT, other  
13 than students and faculty, authorized to use the  
14 PDP-1 at RLE?

15 A We would have allowed them. It would have been  
16 a rare occurrence.

17 Q And then the users, primarily, were affiliated  
18 with MIT; is that correct?

19 A Yes. We had no mechanism for charging any  
20 outside users.

21 Q In your review of Exhibits 4 through 7 and the  
22 entries therein, did you find any references to  
23 Space War?

24 A Yes. I itemized them in my notes, my notes which

1 became part of the evidence yesterday. I think  
2 I numbered some 50 references; and I gave up at  
3 that time, I guess.

4 Q Does the entry of the term "Space War" in these  
5 logbooks have any meaning to you?

6 MR. ANDERSON: I object to the question.  
7 The entries are not here -- at least there's no  
8 evidence to support who made the entries, or his  
9 knowledge of what happened at that time. It's  
10 hearsay; it's speculation; it's opinion.

11 A It was common practice at that period of time to  
12 indicate in the log if you were playing Space  
13 War; that period of time being the period covered  
14 by the most recently mentioned three logbooks.

15 Q Then do I understand correctly that entry of the  
16 term "Space War" means that the PDP-1 was being  
17 used for Space War at the time indicated?

18 MR. ANDERSON: I object to the question.  
19 You're leading the witness. You're testifying  
20 on his behalf. You're asking him to speculate.  
21 It's contrary to his testimony.

22 A Yes. It indicates the game was being played.  
23 It doesn't mean that there weren't other  
24 occurrences.

1 Q Could you refer to Exhibit 8 and indicate whether  
2 that contains any reference to or references to  
3 Space War?

4 A Yes, it does.

5 Q And what are those references on that exhibit?

6 A Well, preparing this, I thought my principal  
7 reason for being here was to present the logbooks,  
8 and probably just point out some places where it  
9 was mentioned; so I started out with the first  
10 reference and page number, second, third, fourth  
11 page numbers. And then I started to tabulate on  
12 one line, the succeeding page numbers.

13 Q What was the first reference? Was there a first  
14 reference to Space War?

15 A Yes. I found it at Page 9 of Book 2.

16 Q And where did you?

17 A My notation, Book 2. It carries a different  
18 exhibit number. The exhibit number is 5.

19 Q And do your notes indicate where you found the  
20 second reference to Space War?

21 A My notes indicate second and third, March 20,  
22 Page 17 of the same exhibit.

23 Q That's March 20 of what year?

24 A 1962.

1 Q Would you also state other places where you found  
2 reference to Space War.

3 MR. ANDERSON: I object to the  
4 testimony. It's hearsay; it's based on entries  
5 that this witness has not made; it's utilizing a  
6 document he prepared to testify here.

7 A The next entry is the fourth, April 13. I have  
8 not carried the '62. I think all of it is '62.

9 More pages; 42, 70, 72, 73, 74, 88; a  
10 couple of entries. More, Page 115, 116, 123, 127,  
11 128, 129.

12 Q Excuse me, now. Were all of those in Exhibit 5?

13 A These are all in Exhibit 5.

14 Q Did you also find references to Space War in  
15 Book 3, which is Exhibit 6?

16 A I continued the search in 3. My notes, looking  
17 in Exhibit 6, my notes indicate --

18 MR. ANDERSON: Same objection to the  
19 continued line of testimony.

20 A Reference Space War, August 24, 1962. I have not  
21 a page number. Continues more: Pages 9, 10, 22,  
22 25, 26, 27, 32, 36, 37, 38, 41, 46, 50, 51, 52,  
23 54, 55, 56, 65.

24 Some entries of pink tape, we discussed

1 yesterday. And Space War, Pages 73, 75. References  
2 to other things.

3 And that would complete the Space War  
4 references in Exhibit 6.

5 Q And did you also look for references to Space War  
6 in the loose-leaf book which has now been marked  
7 Exhibit 7?

8 A Yes. In Exhibit 7, the continued notations  
9 along with other notations.

10 MR. ANDERSON: The same continuing  
11 objection as to your leading the witness through  
12 the next exhibit.

13 A The loose-leaf notebook contains no page numbers;  
14 so I resorted to tabulating by date. The dates --  
15 well, the first entry in the book is January 1,  
16 1963; so that the following dates would be in  
17 1963: 2/12, 2/1, 2/5 -- I'm sorry; strike 2/12.  
18 That's a clock status.

19 The entries are the dates 2/1 -- by  
20 "2/1" I mean February 1 -- 2/5, 2/9, 2/10, 2/11,  
21 2/19, 2/22, 2/24, 3/10. I am not sure whether I  
22 exhausted the limits of the book.

23 MR. WELSH: This would be a good time  
24 to break.

[Luncheon Recess.]

AFTERNOON SESSIONJOHN ALEXANDER MCKENZIE, ResumedDIRECT EXAMINATION, Continued

BY MR. WELSH:

Q Referring to Exhibit 8, yesterday you testified with respect to an entry there regarding new drum wiring, October 26, 1962.

Was the magnetic drum used with the PDP-1 in playing Space War subsequent to that day?

A No. The drum would not even have been operational at that time. This was preliminary wiring.

Q Was it operational subsequent to that time?

A Yes. Not --

Q I beg your pardon?

A Depending what period you're talking about subsequent. It did not come up shortly thereafter.

Q Do you recall approximately how long it was?

A Actually, I think it could have been considerable time beyond that. My recollection is that it was -- well, we built the interface, the drum and the internal control -- that is, the read-write

1 circuitry and all that was constructed by DEC;  
2 and we purchased the drum through DEC. The first  
3 installation went to BB&N; and as I recall there  
4 was rather a long shakedown period before it  
5 became reliable.

6 The delivery of our drum was held up  
7 for some period of time until the problems were  
8 resolved at the BB&N installation; so I think  
9 that delayed it quite some time. I think we were  
10 prepared, but DEC essentially wasn't.

11 Q Was the time of this entry the time of  
12 installation of the drum?

13 A This entry, no. That just pertained to some very  
14 initial preliminary wiring that I started to do  
15 at our end of the interface.

16 Q If you saw an entry in any of these logbooks  
17 regarding the drum at a later date, would that  
18 refresh your recollection as to the use of the  
19 drum?

20 A One of the tapes marked as an exhibit I read this  
21 morning, the tape title punch contained the name  
22 David or Dave, D, Gross. I had the notation  
23 "field dump." That meant it was a punchout of  
24 one of the fields of the drum being discussed;

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1 and the drum would have been operational at that  
2 time. As I recall, that date was 1964 or  
3 something.

4 [Document handed to the witness.]

5 A Yes. It's been marked Exhibit 18; and on what I  
6 call the facing fanfold I had previously read  
7 that one of the comments written on here was  
8 "field punchout." Again, the date is 4/6/64.

9 Q Do you have any independent recollection of the  
10 drum being operational at or about that same time?

11 A No. But I know that, you know, it wouldn't be  
12 customary, maybe two or three or six months'  
13 period from the initial wiring. It was a longer  
14 interval than that.

15 Q I call your attention to Exhibit 7 and the page  
16 therein dated April 11, 1963; and ask you if you  
17 find anything on that page which would refresh  
18 your recollection as to when the drum became  
19 operational.

20 A This would --

21 MR. ANDERSON: I object. This is not  
22 a document prepared by the witness, and it's  
23 hearsay as to him.

24 A It was April '63. I didn't catch the date.

*Doris O. Wong Associates*

1 Q The 11th.

2 MR. ANDERSON: And you're leading the  
3 witness.

4 A Yes. There is an entry on the page 11 April '63,  
5 in my name, lettered; the time, 0800. My comment  
6 is: "Checking LP sequence break request. Change  
7 Space War input. Space War program updated by  
8 P. Samson. Space War on drum not" -- underlined --  
9 "updated."

10 Q Did you make that entry?

11 A Yes. That's my lettering.

12 Q At or about the time indicated on that date?

13 A Yes.

14 Q Can you tell from that entry whether the drum was  
15 operational at that time?

16 A Yes. Whether it was in good enough shape to be  
17 used by all users -- there's usually a shakedown  
18 period while we evaluate a new peripheral. It  
19 certainly was operational. Whether it was in  
20 general use or not is not indicated.

21 Q Do you recall that occurrence?

22 A It certainly is my entry. It was not highlighted  
23 enough that I would remember it.

24 Q Is there any other entry there with respect to

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1 the drum?

2 A Yes; the following entries.

3 MR. ANDERSON: Same objections.

4 A AI(Samson 1210.) I had previously logged off.

5 It's Samson's writing here, to log me off at 1012  
6 [sic]. "Space War on drum is now updated.

7 Continue switch is very sensitive." The continue  
8 switch would be a front panel switch, not on the  
9 drum.

10 Q Do you recognize that as Mr. Samson's handwriting?

11 A Yes; characteristic of his style.

12 Q Did the entry in your lettering include a  
13 reference to Mr. Samson?

14 A It did.

15 Q How did you spell Mr. Samson's name?

16 A It was spelled incorrectly. I included a "p,"  
17 which he does not use.

18 Q During the period represented by the logbooks,  
19 Exhibits 4, 5, 6 and 7, although there were  
20 different versions of Space War, were there some  
21 characteristics of the game which were common to  
22 all of the versions?

23 A I think it would be easier to explain it that  
24 all of the versions were similar, with rather

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1 minor variations between them. They were  
2 basically the same game.

3 Q Could you describe the portions that were similar?

4 A I think we've had reference to the -- the first  
5 was the breadboarded clock, which gave you  
6 control of the number of times or the frequency  
7 at which the control switches were referenced by  
8 the program. I've mentioned the change where the  
9 students built control boxes, indicated by the  
10 instruction IOT 11; they were used.

11 We had an earlier reference this  
12 morning about the version that was used utilizing  
13 the knobs, switches and buttons panel, which we  
14 had to construct and provided as a user input.  
15 Those were variations which I'm more familiar  
16 with. Users would have had private versions, I'm  
17 sure; that is, they modified the software. I  
18 couldn't speak to those type changes.

19 Q I believe you've been discussing changes in --

20 A Space War.

21 Q Yes. Would you now describe the similarities of  
22 the various versions.

23 A The computer display, the outline of the ships,  
24 always appeared to be the same. The star

1 background in the earlier versions, when the game  
2 was rather slow, sluggish feel to it -- they  
3 sometimes had the option of not using the star  
4 background, because that was overhead.

5 I've testified toward the options about  
6 having a different feel to the game depending  
7 upon the weight of gravity, or no gravity at all;  
8 and that gravity force could have been changed  
9 by any of the programmers who had access to the  
10 listing and knew where the constant was that's  
11 described in some of the listings, among the first  
12 15 locations of the program.

13 And the other flexibility that you had  
14 was being able to vary the speed of what was,  
15 first, the breadboard clock. At some time in the  
16 sequence, we installed a similar clock which was  
17 built in; no longer a breadboard input. We  
18 called it the ESL clock. I couldn't say offhand  
19 whether or not I used the same IOT. It would  
20 have been my first -- in order to maintain  
21 compatibility, that would have been my first  
22 objective. However, there may have been some  
23 other reason at that time for not doing it. So  
24 it would have been a simple change from the

1 breadboard clock to the PSL clock. It still  
2 continued to be variable with a knob for fine  
3 control, and switches that selected a course of  
4 selection, an RC oscillator circuit. And the  
5 significance of the clock is that it gave a  
6 different feel, flavor to the game; that is, the  
7 sensitivity of the controls. If the clock was  
8 set at a very slow rate, the ship would appear to  
9 be terribly sluggish. If you went to the extreme  
10 where it became unmanageable, it would turn, the  
11 clock frequency would turn up very high. You  
12 might have the occasion where you'd try to change  
13 your bearing a little bit to the left, and you'd  
14 have a 180-degree turn before you could release  
15 the switch. That's the extreme.

16 And somewhere in between, it was varied,  
17 depending on the skill of the user. An unskilled  
18 user could not tolerate as high a speed; whereas  
19 the skilled user wanted a little bit higher  
20 performance simulation.

21 Q With respect to the display, I believe you stated  
22 that a similarity was that the shapes of the  
23 spaceships were the same.

24 A Yes. I could not see any difference in that.

1 Q And was the number of spaceships the same?

2 A At that time, it was two. The current version,  
3 when you load the program from DEC tape, the  
4 program sits and waits for an input from the  
5 typewriter; and you can type the number of  
6 players. I'm not sure of the limit. We usually  
7 take two.

8 Q Was the movement of the spaceships similar or  
9 different in the various versions?

10 A It was similar; but, well, the movement is greatly  
11 controlled by the constant they put in which  
12 controlled the gravity force of the central star  
13 or sun; the term used interchangeably.

14 Q In each version, was there a control to turn the  
15 ship, each ship, left or right?

16 A Oh, yes.

17 Q And was there a control operable by the player  
18 to turn his ship or to accelerate his ship?

19 A Yes.

20 Q And did each player have a control by which he  
21 could cause torpedoes to be fired from his ship?

22 A Yes.

23 Q In each version, when a torpedo hit a spaceship,  
24 did the ship explode?

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1 A Yes.

2 MR. ANDERSON: I object. You're leading  
3 the witness.

4 A Yes. One of the variations would be that, there  
5 again, in the front end of the listing there are  
6 constants which control the proximity. There's  
7 a concept of proximity fuse in a torpedo; and  
8 that range certainly could be varied from user to  
9 user. I'm not too sure we ever settled on one  
10 as being best.

11 There is the idea, the concept, of the  
12 life of the torpedo. You don't want them  
13 floating around in space forever in collision  
14 range.

15 Q When spaceships collided, was the result the same  
16 or different in the various versions?

17 A It looks like an explosion. There is a display  
18 of dots which expand outward. It's a simulation  
19 of what you would -- it's a realistic representa-  
20 tion of an explosion.

21 Q Did that occur in all versions?

22 A Yes.

23 Q Did the torpedoes ever collide? Did any two  
24 torpedoes ever collide?

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1 A Yes. They will show a similar explosion, but in  
2 a smaller scale. By "scale" I mean, that is,  
3 radius of explosion. One technique is to shoot  
4 down the torpedo coming to you.

5 Q When you first referred to DECUS this morning,  
6 I believe you referred to a spring joint computer  
7 conference.

8 A I said my interest in starting to peruse the  
9 DECUS newsletter specifically was that I recalled  
10 that in conjunction with one of the computer  
11 conferences held in Boston -- I could not say  
12 whether it had been the spring joint computer  
13 conference which had been held in Boston in its  
14 early days, or the NERIM exhibit -- not exhibit;  
15 NERIM meeting, with its attendant exhibit --  
16 which is the point I was getting at, that DEC  
17 in their exhibits had a computer which was  
18 playing Space War. I was trying to find a  
19 reference to that.

20 Q Did you attend that conference?

21 A The ones with the spaceship -- with DEC, yes.

22 Q Did you see that demonstration of Space War?

23 A Yes.

24 Q You may have answered this; I don't recall. Do

1       you remember the year when that demonstration  
2       took place?

3       A     No. I think it was soon enough after we had it  
4       that we were surprised that DEC had it. By  
5       "soon enough," it could be anywhere from a year  
6       to two years. I have difficulty tying that down.  
7       It was worthy of comment among the group that  
8       DEC did have a Space War game at the show.

9       Q     What computer was it displayed on?

10      A     I'm not sure.

11      Q     Was the game, the Space War, that you saw at that  
12      demonstration similar or different than the one  
13      you had known at MIT?

14                 MR. ANDERSON: I object. The witness  
15      has said he doesn't even know what computer it  
16      was on. Lack of a foundation. Hearsay.

17      A     I'm not sure that I had great enough interest in  
18      it to give an evaluation of that sort. It  
19      appeared to be the same game; but as far as the  
20      outlines of the ship, or the presentation, I  
21      couldn't tell you.

22      Q     Do you recall whether DEC used any promotional  
23      literature in connection with that demonstration?

24      A     They always had a great deal of handouts

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1 available to you. I don't recall a specific  
2 piece of brochure or pamphlet.

3 Q Referring to the period of September 1961 through  
4 June 1963 covered in Exhibits 4, 5, 6 and 7, at  
5 that time were you familiar with the components  
6 of the PDP-1 computer and their operation?

7 A It was a standard PDP-1 computer during that  
8 interval, with the very minor modifications that  
9 I've mentioned; and it's not really considered  
10 a modification, rather an add-on. The PDP-1  
11 computer had a rather nice input-output facility  
12 in what they called Bay 3, where it was a simple  
13 matter to add the IOT 11 input, where the computer  
14 could sense the control boxes made up by the  
15 users.

16 The same statement applies to the  
17 breadboard patch cord-type clock and the ESL  
18 clock. I'd say the first really significant  
19 changes were the work referenced in the initial  
20 wiring and preparation for adding the storage  
21 drum.

22 Q Did you become familiar with the original  
23 components that remained as these additions were  
24 made and the operation of those components?

1 A Well, I maintained the machine. When the machine  
2 was going through tests out at DEC, I went out  
3 there one or two or three days a week, depending  
4 on my workload, and participated in the checkout,  
5 and worked along; so I'd have quite some  
6 familiarity with it.

7 Q Did you have occasion to use any circuit diagrams  
8 or logic diagrams?

9 A Yes.

10 Q At that time?

11 A Well, we did have failures.

12 Q Did you bring any drawings with you -- that is,  
13 drawings which would show the components or  
14 operation of those components of the PDP-1?

15 A In compliance with the attachment of the subpoena,  
16 which referenced drawings, wiring diagrams, flow  
17 charts, et cetera, I brought along a set of  
18 drawings which DEC had issued along with their  
19 maintenance manual, which in turn was delivered  
20 sometime after the computer was installed. This  
21 was a set of drawings that was sort of earmarked  
22 to go with that. A similar set was used in  
23 conjunction with a computer maintenance course  
24 which they offered PDP users; and a set of this

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1 type, category, this consist, was given.

2 Q Now, may we see those drawings?

3 [Documents handed to Mr. Welsh.]

4 MR. WELSH: Perhaps, in the interests  
5 of saving time, I'd like to make the same request  
6 that we made with respect to the other documents  
7 that you've produced; namely, that we be  
8 permitted to mark these as exhibits with the  
9 understanding that they will be retained by us  
10 during the course of the litigation and returned  
11 when the litigation is completed.

12 Mr. Shaw, this type of understanding  
13 and agreement was agreeable with Mr. Horn and  
14 also with Mr. Smith with respect to the other  
15 documents that were produced by Mr. McKenzie.

16 MR. SHAW: Yes.

17 MR. WELSH: Okay.

18 I'd like to ask the Reporter, then, to  
19 commence marking these starting at the bottom one  
20 and numbering them consecutively from 25 for the  
21 bottom one and 26 for the next one, and so on.  
22 There appears to be a rectangular box in the  
23 lower portion of the right center part of each  
24 page which is empty; that would be a good place

1 to mark it.

2 [Discussion off the record.]

3 THE WITNESS: I think this is of  
4 general interest.

5 MR. WELSH: I'd prefer to have the  
6 comments on the record, I think, if you'd like to  
7 make some comments.

8 THE WITNESS: I'm not talking towards --  
9 I'm not talking towards the prints.

10 MR. WELSH: These particular drawings?

11 THE WITNESS: That's right.

12 MR. WELSH: Very well, then; off the  
13 record.

14 [Discussion off the record.]

15 [Group of blueprints, marked  
16 MIT Deposition Exhibits Nos.  
17 25 through 45, 45-A, and  
46 through 48 for identifi-  
cation.]

18 Q Mr. McKenzie, you have handed me a group of  
19 drawings which you took out of a single envelope  
20 and which have been marked by the Reporter as  
21 Exhibits 25 through 48, with one, Exhibit 45-A,  
22 apparently a duplicate of Exhibit 45.

23 What do these drawings represent?

24 A They are the drawings with the description of the

1 logic and the hardware implementation of the  
2 PDP-1 computer. Those are not my working  
3 drawings. I had a set of working drawings  
4 similar to these filed in a big book; but that  
5 particular set was issued to me from DEC as being  
6 a set of drawings for the PDP-1 to be used in  
7 conjunction with the maintenance manual which was  
8 delivered together with those drawings as  
9 necessary to use them together.

10 Q Do they represent the PDP-1 as it was delivered  
11 to RLE?

12 A Yes.

13 MR. ANDERSON: Objection to the lack of  
14 a foundation.

15 A The PDP-1 as delivered to MIT was a standard  
16 PDP-1.

17 I have not gone through these drawings.  
18 I couldn't tell you that every drawing pertaining  
19 to the machine is there. That was delivered as  
20 a representative set of drawings.

21 Q Do you recall when you received this particular  
22 set?

23 A Their documentation was always right; and as a  
24 guess, the maintenance manual was probably six

1 months after the delivery of the machine. I'm  
2 not sure of the six months; but it was not the  
3 next week or not the next month. Sort of a  
4 general time scheme.

5 Q Was it within the first year?

6 A Yes, I'd guess it was.

7 Q Where did you obtain this set in preparation for  
8 appearing at this deposition?

9 A That particular set was kept in my desk drawer.

10 Q Have you had possession of it in your desk drawer  
11 since you received it initially?

12 A Yes, I did.

13 Q Have you had occasion to refer to it since that  
14 time?

15 A No. I had another set of working drawings; and  
16 within three years, as we started to modify the  
17 machine, these drawings became obsolete for our  
18 purposes.

19 Q Did you refer to these drawings at all during the  
20 time after they were delivered and before you  
21 removed them to bring to this deposition?

22 A There again, not those specific drawings. I had  
23 a similar set, what I call my working drawings.

24 Q Did you bring them here intact, as they were when

1           they were delivered to you?

2   A       I did.

3                   MR. ANDERSON:  You're referring to  
4       Exhibits 25 through 48, Mr. Welsh?

5                   MR. WELSH:  Yes; and including 45-A.

6   Q       What comprises your working set of drawings?

7   A       I have a large number of books, large -- what's  
8       commonly called the Accopress binder, only with  
9       a front cover this size.  I don't see anything  
10      here.  Is that trade name sufficient?  Are we  
11      familiar?  It's the loose-leaf binder that has a  
12      front cover such as this.

13  Q       That is Exhibit 4?

14  A       Yes.  I have several books.  One is labeled  
15      "CPU."  One is labeled "Bay 6 7 10."  Another book  
16      is labeled "Microtapes."  Another book labeled  
17      "Memory."  They are still working drawings, one  
18      of a kind.

19  Q       Do you still have that working set?

20  A       Yes.  I still require those in order to maintain  
21      the machine.

22  Q       You're still using them today; is that correct?

23  A       Yes.

24  Q       I mean, at this current period of time?

1 A Right. Right.

2 Q Have the drawings in that set changed -- strike  
3 that.

4 When did you first assemble a working  
5 set of drawings?

6 A That was a continuing situation, from 1963 at  
7 least through 1970.

8 Q Did you use that working set from day to day in  
9 your maintenance of the PDP-1 computer?

10 A Yes; even more frequently in our large-scale  
11 modifications which were going on. In fact, they  
12 do represent modifications.

13 Q When you first assembled your working set of  
14 drawings, what drawings were included in that  
15 set?

16 A The initial working set would have been a set of  
17 drawings issued by DEC; that is, DEC's drawings  
18 of the PDP-1.

19 Q Identical with the ones marked as Exhibits 25  
20 through 48?

21 MR. ANDERSON: Objection. You're  
22 leading the witness.

23 A They could have been --

24 MR. HERBERT: Let the record show that

1 during the first statement he was pointing to  
2 those exhibits.

3 A Revision date could have been different. I cannot  
4 guarantee that this is a complete set. But they  
5 were, in any event, DEC drawings of the DEC  
6 PDP-1 computer. None of them originated by me at  
7 that early date; that is, the first year.

8 Q Did you also receive those original drawings  
9 along with the working manual?

10 A No. The original drawings were delivered with the  
11 computer, or within the next couple of days, when  
12 the checkout was performed by DEC. Probably the  
13 latter was more likely the case.

14 Q And were those drawings delivered with the  
15 original computer, as part of your working set?

16 A Yes; they were the working set.

17 Q Did the drawings in your working set change from  
18 time to time?

19 A Yes. We made notations.

20 Q Were you furnished new drawings by DEC which you  
21 substituted for drawings in the original set?

22 A No. We generated our own drawings to show the  
23 revisions.

24 Q Does your working set as you now use it include

1 all of the original drawings which were in the set  
2 at the time it was started?

3 A Indeed not. I probably -- my working set as  
4 presently used, 98 percent -- how to tie that down--  
5 are prints of my origin; that is, MIT origin. Let  
6 me say that.

7 To be very specific, the duplicate set  
8 of prints in there, oddly enough, are still  
9 applicable. I think it references core memory.

10 Q You mean the print marked "Core Memories" here  
11 is one that's still current?

12 A That is still applicable.

13 Q Have you examined these at all since you withdrew  
14 them from your desk to bring here?

15 A I did not even unfold them.

16 Q I'd like to ask you now to take these one by one  
17 and, referring to the exhibit number if you could,  
18 identify each drawing.

19 MR. ANDERSON: I object. The drawings  
20 speak for themselves. If he's just going to  
21 read the blocks on the drawings, it seems a waste  
22 of time, and immaterial and irrelevant. It can't  
23 add anything to what's in the drawing.

24 Q Would it be possible, Mr. McKenzie, to, as you

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1 examine each of these drawings, as you identify  
2 them, examine them briefly and tell us whether  
3 you had similar drawings in your original set,  
4 and whether these are the same or different than  
5 those original drawings?

6 A I couldn't say. Obviously, looking at the  
7 revisions chart, table, here, they were updated  
8 rather frequently. May I see some representative  
9 dates? 6/1, 6/4, 8/15, 10/5. And it's likely  
10 that I had an earlier version of some of these.

11 Q And what year were those revisions you just read?

12 A The 6/1, the last numeral is not legible; but  
13 it's preceded by a '62, and all of the following  
14 are '62.

15 Q Mr. McKenzie, are you able to read and understand  
16 these drawings and tell us what they relate to  
17 individually?

18 A Yes. My reluctance, my inherent reluctance, to  
19 do that is that every time I try to talk about  
20 something of this nature I can't help but  
21 introduce a word, a phrase, that I have to define;  
22 and it's pretty difficult to try to explain these  
23 without introducing a little bit of terminology.  
24 I'd be glad to go ahead.

1 Q Well, perhaps we could try it without your  
2 attempting to explain the terminology, unless a  
3 question is asked about it. If we could do that,  
4 I would like to have some indication from you as  
5 to what each drawing relates to, what part of the  
6 machine -- that is, the PDP-1 -- it related to;  
7 and, if possible, the function of the part  
8 generally, the parts shown on the drawing.

9 I hand you first Drawing No. 48, or  
10 Exhibit No. 48.

11 A Exhibit No. 48 had no meaning originally. This  
12 is more memory extension. The title is "Memory  
13 Extension Control." And we only had a single  
14 module of memory; that is, 4,000 words. And this  
15 wouldn't have been applicable.

16 Q Was it subsequently applicable?

17 A No. It turned out that when we expanded memory,  
18 we built our own extension.

19 Q If you would go through each one, referring to it  
20 by exhibit number in that same manner.

21 A Exhibit No. 47, labeled "Memory Extension Control  
22 Type 15 Memory Buffer Mixer PDP-1"; the same  
23 remarks apply to this drawing as Exhibit No. 48.

24 Q Would you now take Exhibit 46.

1 A Exhibit No. 46, "Punch Control PDP-1." This  
2 contains the buffer register where the code that  
3 is going to be punched out as output from the  
4 punched paper tape is stored, when it's  
5 transferred from the computer. Specifically,  
6 it's transferred from the computer IO register  
7 here, which means in-out register. It also has  
8 the solenoid drivers, which are energized two to  
9 one, or conversely to a zero, depending on the  
10 code which is stored in the PB register --  
11 namely, the punch buffer register, Bits 10 through  
12 17.

13 Q Those are boxes marked "PB," with a sub --

14 A They represent a flipflop; and they're one of  
15 four in a DEC Type 4214 module.

16 Also, on the drawing, there is a pickup  
17 coil which is used to synchronize the punch.  
18 There is a wheel that turns once a revolution,  
19 and which may be best described -- there is an  
20 index point on there. This is sensed pickup.  
21 And that allows you to start at the proper time  
22 sequence to tie in the mechanical motion of the  
23 punch with the control pulses which are coming  
24 over from the computer. That is, when the computer,

1 when the punch is punching a stream of paper tape,  
2 it runs continuously.

3 We also have the logic which accepts  
4 the -- which first clears the punch paper buffer  
5 and later the punch buffer. We have two ways of  
6 punching tape. One is the alphanumeric mode, and  
7 this ties in in the same sense that we talked  
8 about source tapes and English tapes yesterday.  
9 The PB, the other, punch binary, refers to the  
10 binary tapes which we've discussed.

11 Q Would you now refer to Exhibits 45 and 45-A and  
12 examine those; and tell us if you can, first,  
13 whether they're duplicates.

14 A I would be satisfied that they each bear the same  
15 revision change number date. My activity, I would  
16 equate them to be the same. It's customary, if  
17 you modify the original, to put an entry in the  
18 change number, and a date.

19 Q Before I go further to ask you about those  
20 exhibits, I'd like to show in the record that  
21 Exhibit 48 bears a drawing number D-21103-C, the  
22 title "Memory Extension Control Type 15 Transfer  
23 and Selection Logic PDP-1"; initials "BS"; and  
24 above the title box the legend "Figure D8-6."

1 In the lower right-hand corner, it  
2 bears the number D-21107 and the title "Memory  
3 Extension Control Type 15, Memory Buffer Mixer  
4 PDP-1 BS"; and above that the legend "Figure D8-5."

5 I might note also that Exhibit 48, in  
6 the box marked, or with the lettering drawn,  
7 includes the name "A. Yarkstas" -- it appears to  
8 be Y-a-r-k-s-t-a-s -- and a date, 12-20-61.

9 MR. ANDERSON: Mr. Welsh, I suggest  
10 that rather than your struggling and trying to  
11 read those names, we let the documents speak for  
12 themselves. Your testimony can't help a bit.  
13 They've been marked by the Reporter.

14 MR. WELSH: I know. I'd like to have  
15 this much information identifying each one in the  
16 record.

17 Also, on Exhibit 48, in boxes labeled  
18 "Changes," there appear six changes bearing  
19 various dates up to October 5, 1962.

20 MR. ANDERSON: Mr. Welsh, could I  
21 suggest that we let the witness testify; and  
22 we'll stipulate that you can read those all into  
23 the record at the end of the day after we go  
24 home. It's all right with me.

1 MR. WELSH: All right; that's fine.  
2 I might as well finish with Exhibit 47, as long  
3 as I've started that.

4 Again, in the box labeled "Drawn," it  
5 contains the name "A. Yarkstas" and the date  
6 5/20/61. In the box marked "Changes" are five  
7 different entries, with the latest being June 2,  
8 '62 -- 6-2-62.

9 In Exhibit 46 --

10 MR. ANDERSON: Mr. Welsh, if you're  
11 going to persist, I want to state that we will  
12 seek from the court compensation for time and the  
13 cost of the transcript if you're going to  
14 continue to read at length from these documents.

15 MR. WELSH: I just wanted to complete  
16 the ones that I had already commenced at the same  
17 part of the transcript in which the other portions  
18 appear. I am willing to put the rest of the  
19 information on the record after this witness has  
20 testified.

21 Exhibit 46 also, in the box marked  
22 "Drawn," indicates "A. Yarkstas" with a date  
23 5/15/61; and in the box marked "Changes" there  
24 are five entries bearing dates the latest of which

1 is 7/11/62.

2 Q Now, Mr. McKenzie, would you refer to Exhibit 45  
3 and tell us what that drawing shows.

4 A Yes. It's a print of the memory module, DEC's  
5 Type 12, PDP-1. The BS reference is box schematic.  
6 This is a similar set of wiring diagrams which  
7 were a pictorial view of the wiring of the card  
8 cage, the wiring side of the card cage. The  
9 Figure 98-3 and similar references, I had earlier  
10 testified that these were delivered with the  
11 maintenance manual; and the maintenance manual  
12 references these figure numbers.

13 Q Those are the figure numbers?

14 A Referenced in the --

15 Q Above the --

16 A Above the title.

17 Q Title box?

18 A Title box.

19 Q And in this case, is it Figure D8-3?

20 A D8-3.

21 Q I notice, after folding Exhibit ---

22 MR. ANDERSON: 45?

23 Q -- 45-A, which above the title box bears the  
24 legend "Figure D8-3," that on the outside of the

1 folded drawing appears the legend "8-3." Is that  
2 correct?

3 A There is the figure number and the index number,  
4 agreeing?

5 Q That was on Exhibit 45-A. Now I hand you Exhibit  
6 45 and ask what legend appears above the title  
7 box there.

8 A 45 has the entry "Figure D8-3" for the memory  
9 module, Type 12; and the Exhibit 45-A is the  
10 duplicate copy.

11 Q Now, Exhibit 45-A has the numbers "8-3."

12 A File index number; 8-3.

13 Q Is there a corresponding number on Exhibit 45?

14 A Yes. The 8 is stamped. Somebody has added in  
15 pencil "-5." It's not my entry.

16 Q Do you know why there would be that difference  
17 between the drawings?

18 A I never used those drawings.

19 Q I now hand you Exhibit 44 and ask if you could  
20 tell us what is represented on that drawing.

21 A Yes. The title block contains the title  
22 "Standard In-Out Transfer Control PDP-1 BS."  
23 Above the title block, "Figure D9-1." I'm  
24 reading from Exhibit 44. And the serial number

1 of the drawing, D-20054-B. There are revisions  
2 running through 7-5-62, initialed EH; Ed Harwood.  
3 Q Can you tell us in what part of the machine this  
4 would be located or was located?

5 A Yes. This is what DEC calls Bay 3. This is  
6 evidenced by the -- I've testified earlier without  
7 reference to this; the locations are included  
8 within each of the dotted lines. That represents  
9 a module. And if we take for-instance, 3H7 in  
10 that, that memory module is a Type 4603, which I  
11 recognize as being three pulse amplifiers within  
12 one module. The individual boxes are labeled  
13 PA<sub>1</sub>, PA<sub>2</sub>, PA<sub>3</sub>; and the locations where this  
14 particular one is wired in are in Bay 3. The H  
15 refers to the elevation. Since we have a series  
16 of these card cages, starting Z, YZ, ABCD through  
17 L, we must be careful here that in DEC's alphabet  
18 some letters are not used. For instance, I is  
19 not used, and all that. So those limits can't  
20 be referenced for particular numbers.

21 And the other general comment about  
22 this is that this is the logic which the user  
23 utilizes to implement his special custom-built  
24 connection to the PDP-1. Earlier references to

1 IOT 11, the building block clock, the ESL clock,  
2 would all have been implemented using this  
3 facility.

4 I don't know whether you want -- how  
5 much more you want me to expand on that. I  
6 haven't begun to cover it. It would take ages;  
7 take a week.

8 Q You stated that this legend, "Figure D9-1," and  
9 similar legends on Exhibits 45 and 45-A, were  
10 references to the manual. Is that correct?

11 A Yes. The set of drawings and the manual were  
12 delivered together. However, I never utilized  
13 these drawings or made use of figure numbers.  
14 I recognize areas from my own prints. I cannot --  
15 I'd be willing to accept that DEC's notation is  
16 correct. I can't say from use.

17 Q Can you refer to Exhibit 10 and -- do you know  
18 what part of the manual, Exhibit 10, is referred  
19 to in this legend, "Figure D9-1"?

20 MR. ANDERSON: And you direct his  
21 attention to Page 9 of Exhibit 10; is that right?

22 MR. WELSH: Yes.

23 Q As I hand it to you, Page 9 is open.

24 MR. ANDERSON: I accept your leading of

1 the witness, just to get the job done. If you  
2 have a particular block in mind, Mr. Welsh, why  
3 don't you just point to it.

4 A It's not representative of this page.

5 Q Is that the manual you referred to?

6 A This is MIT Exhibit 10. The user's in-out  
7 control panel, the in-out transfer panel, is not  
8 represented here. This is not really the heart  
9 of it. This logical representation, flow chart,  
10 block diagram better described, shown on Page 9  
11 is the principal part of the computer. The  
12 computer would run very well without all this.  
13 It is utilized to tie in the peripherals, such  
14 as the punch, display, and reader and on through  
15 the user's custom --

16 MR. ANDERSON: The witness said "all  
17 this"; he was referring to Exhibit 44.

18 THE WITNESS: Yes. Sort of a general  
19 input-output transfer accommodation.

20 Q In the legend "Figure D9-1," did you state that  
21 refers to some part of the PDP-1 manual?

22 A It's not shown on the block diagram on Page 9  
23 to which you've directed me.

24 Q Is this the same manual that you were talking

1 about when you said --

2 A No, no, no; by no means. The maintenance manual  
3 that I'm talking about would have been a DEC  
4 publication with a black cover rather than a pink  
5 cover, somewhat thicker than this, delivered with  
6 an explanation of the theory of the machine, and  
7 to enable somebody to maintain the machine; and  
8 all of this was used in conjunction with a  
9 maintenance course which was offered by DEC. It  
10 ran two weeks, I believe; where they thoroughly  
11 ran through all of these drawings and tied them  
12 in with the description.

13 Q So the maintenance manual that you referred to  
14 as being accompanied by this set of drawings was  
15 a larger loose-leaf manual; is that correct?

16 A Yes. Yes. The same physical outline as Exhibit  
17 No. 7, only somewhat thicker; and of course it  
18 was a printed document.

19 Q So that manual that you referred to as  
20 accompanying these drawings and bearing the  
21 references above the title block on each drawing  
22 was not Exhibit 10?

23 A No, no. This is just a handbook, you know, as  
24 opposed to the logic organization. They might

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1 well have had another block label, transfer  
2 panel. The reason they didn't choose to, it's  
3 not really the heart of the machine.

4 Q Do you know what happened to the maintenance  
5 manual that did accompany these drawings?

6 A Yes. I have it in my office.

7 Q Do you use the manual, or have you used it, in  
8 your day-to-day maintenance of the PDP-1?

9 A I've made use of it in some of the work on  
10 memories. There are some references in there as  
11 to how to set adjustments on the sense amplifiers,  
12 level adjustments, thresholds and this sort of  
13 thing.

14 Q Do you have more than one copy of that manual?

15 A No.

16 Q And the one copy you have is the working copy?

17 A Yes. I would be handicapped if I were to lose  
18 it.

19 There was a preliminary copy issued.

20 It's not very complete, not very worthwhile.

21 Whether I still have that or not, I do not know.

22 Q Would what you've referred to as the preliminary  
23 copy be similar to the manual which accompanied  
24 the set of drawings, Exhibits 25 through 48?

1 A Whether the figure references were consistent or  
2 not, I have no way of knowing. As I say, I did  
3 not utilize figure references.

4 Q But do you know whether the preliminary manual  
5 you just spoke of was like one that accompanied  
6 this set of drawings?

7 A It was a first draft, with lots of errors on the  
8 first pass. I think it was delivered piecemeal,  
9 you know, with some of the chapters but not all  
10 of the chapters. Not all of the chapters had  
11 been at that time.

12 Q Has the maintenance manual which you now use  
13 previously had any changes made in it?

14 A I'm not sure that I wouldn't have put in an  
15 indication of whether the adjustment was the rear  
16 one or the front one; things of that nature.  
17 But I haven't really written any of the  
18 description, or found fault with it.

19 Q Do you recall when you received the maintenance  
20 manual which you now use as a working manual?

21 A I think I testified earlier that was some six  
22 months afterwards; and that six months is just  
23 a ballpark figure. I think that was the one I  
24 used before.

1 Q Six months after the PDP-1?

2 A Yes.

3 Q That early?

4 A That could have been not minus six months, but  
5 could have been six months beyond that.

6 Q And have you made additions to that manual since  
7 that time?

8 A No. Our modifications are not written up in that  
9 fashion.

10 Q Did you receive any additional information sheets  
11 from DEC to be added to the maintenance manual?

12 A There may well have been another chapter that was  
13 sent down later. I don't directly recall that  
14 there was.

15 Q I ask you to look at Exhibit 43 and tell us what  
16 that represents.

17 A Title block, "In-Out Input Mixer PDP-1 BS."  
18 Above the title block, "Figure D9-2." Revision  
19 number, 6-4-62; initialed EH, Ed Harwood, the  
20 engineer.

21 Q Did you know Mr. Harwood?

22 A Yes. I knew him at Lincoln Lab before he went to  
23 DEC. I had met him at DEC in connection with  
24 picking up the PDP-1.

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1 Q Do you recognize those initials as his?

2 A Not his initials, but the name. His name is also  
3 in the block beneath, within the title block,  
4 "Engineer"; signed by E. Harwood.

5 Q What is the function of the in-out input mixer?

6 A Yes. This is a way, this is the provision, where  
7 multiple inputs from outside the computer are  
8 directed into the in-out panel -- in-and-out  
9 register, rather. This is the port through which  
10 digital users, digital inputs, are brought into  
11 the computer. Now, some of these have previously  
12 been utilized in the standard DEC machine; and  
13 anything that's indicated on the print -- for  
14 instance, B00051 LP1 -- these are all peripheral  
15 devices which utilize this as a connection to the  
16 machine. This is a way to get information,  
17 digital information, into the computer.

18 The input is controlled by putting an  
19 enabling pulse -- well, the value of the  
20 information that you want to put in for each bit  
21 is determined that, i.e., a one or a zero on the  
22 vertical lines which extend down from the boxes.

23 Q That's at the lower left corner of the drawing?

24 A Yes. This is typical of all the other boxes of

1 the 4129 module. And the horizontal lines coming  
2 into those are the pulses -- we think of them as  
3 strobe pulses -- which come along under computer  
4 control, which are generated when the appropriate  
5 IOT instruction is executed; and that is the time  
6 that this information is advanced into the IO  
7 register.

8 I'm mixing the computer terminology  
9 and layman's terminology. I'm trying to do both.  
10 Q Do the modules of which you were describing the  
11 operation of one on this drawing bear any  
12 identifying numbers?

13 A Yes. That particular one is labeled 4129. That's  
14 a capacitor diode input mixer. The level that I  
15 first mentioned coming on the vertical lines,  
16 they are charging up a capacitor; so that there  
17 is a restriction on this, that you must allow  
18 one microsecond of charge time while you set up  
19 this level; and after that it's legitimate to  
20 strobe that information into the computer.

21 Q And when you say "strobe" --

22 A I mean pulse.

23 Q The pulse.

24 How does the pulse enter? You pointed

1 to four horizontal lines.

2 A It's a coincidence of the pulse occurring and  
3 the presence of a level designating either a  
4 one or a zero on the bottom of the vertical lines,  
5 the vertical inputs, labeled TVXZ; and these all  
6 get mixed together.

7 You notice that the end result is one  
8 line going up to IM 1, which is the Signal Input  
9 Mixer 1. But we have some eight inputs funneled  
10 into that. Eight, definitely; eight inputs  
11 funneled into that. The action takes place on  
12 the horizontal line which is strobe-enabled at  
13 that time; and only one of these could be  
14 enabled. Each one has its own designation; by  
15 "designation," IOT.

16 Q When you used the term "horizontal line," you  
17 pointed to the --

18 A The inputs coming in on SUW and C.

19 Q At the left side of the lowermost module in that  
20 drawing, Exhibit 43?

21 A Right.

22 Q Would you now refer to Exhibit 42, please; and  
23 tell us what is depicted in that drawing.

24 A Yes. "Memory Buffer Register PDP-1 BS." Serial

1 No. D-200 -- I believe it's 50-B. It carries the  
2 figure number, above the title block, D8-2.

3 That's Revision No. Date 6-4-62; initialed EH.

4 The memory buffer register which this  
5 shows is the register where memory -- where data  
6 is stored while it's being transferred to or  
7 received from the core memory.

8 Q Would you refer now to Exhibit 41 and tell us  
9 what is depicted on that drawing.

10 A Yes. Title, "Memory Extension Control Type 15  
11 Transfer and Selection Logic PDP-1 BS." Serial  
12 number, D-21103-B. Revision date, 6-4-62.  
13 Initials, EH. Figure D8-6.

14 The first thing I see is that I have  
15 lettered my name in the lower right-hand corner.

16 Q Above the title box?

17 A Yes.

18 Q Do you recall what occasioned your lettering your  
19 name on there?

20 A No.

21 Q You read a revision date of 6-4-62. Is that the  
22 latest revision date, on that line?

23 A I would hope that the latest one is always the  
24 bottom one of the chain.

1 MR. ANDERSON: Mr. Welsh, I object.  
2 I thought you were going to read that into the  
3 record later. I'll stipulate that all the  
4 revisions say what they say; and you can read  
5 them all in, if you want them in the record --  
6 including the title block, the name of the man  
7 that drew it, and the names that appear in the  
8 title block. You're just protracting this  
9 proceeding unreasonably, for no purpose that I  
10 can see.

11 MR. WELSH: I'd like to ask the witness  
12 just to explain what the drawing depicts, without  
13 necessarily reading the revisions.

14 Q I would like to have you read the title, however.

15 A This is the memory extension control which we've  
16 seen earlier. We did not install it on the  
17 machine; we built our own.

18 Q Now, I hand you Exhibit 40 and ask if you could  
19 tell us what is depicted there.

20 A The typewriter control, PDP-1. This is the  
21 interface to the on-line typewriter.

22 Q Interface with what?

23 A Specifically, this was interfaced to an IBM  
24 Model B Soroban, modified by Soroban. It was a

1 standard IBM typewriter that was modified by  
2 Soroban, Melbourne, Florida, to become an input-  
3 output writer, commonly called the on-line  
4 typewriter.

5 Q What was the input to this, sir?

6 A Well, the input is the keyboard; and the Soroban  
7 modification brought in the character code on  
8 the relay contacts depicted in the lower left-hand  
9 corner. These relay levels were put in through  
10 switch filters which reduced the relay voltage,  
11 which is usually 15 volts, to the DEC standard  
12 logic, which is ground minus three, two states  
13 or levels. And from there, it's transferred  
14 digitally to the computer and to the IO register  
15 by the input mixer which we discussed earlier.

16 It says "Typical to IM 12," which means--  
17 this is one of the ways I discussed. We funnel  
18 in all of these devices. It also shows the output,  
19 which I haven't discussed.

20 Q Where is that?

21 A Well, the upper right-hand corner shows the  
22 solenoid drivers which activated the keys and  
23 gave you the hard copy out.

24 Q Would you now refer to Exhibit 39 and tell us

1 what is depicted there, please.

2 A Yes. Do you want all the title block?

3 Q I think just the title is all.

4 A "Taper Pin Panels and In-Out Plugs for Optional  
5 Equipment PDP-1 WD," wiring diagram.

6 I earlier referenced a drawing that  
7 talked about -- I think I mentioned Bay 3, and  
8 the in-out panel. Those levels would be available  
9 at taper pin receptacles, where you plug in a  
10 taper pin and generate your own logic.

11 Yes; generate, make up your own IOT  
12 transfer instructions.

13 However, some of those were reserved  
14 for standard options; and the columns on the left  
15 half of the drawing represent the plug spaces,  
16 which are not always wired, but were made  
17 available; where DEC could come down and readily  
18 plug in a standard option. And it indicates not  
19 by pattern, but the -- there were IOT's reserved  
20 for the standard options.

21 Q You were referring to the portion on the left  
22 side?

23 A The columns on the left represent a 50-pin  
24 connector. Each represents a 50-pin connector,

1 which was where the peripheral device would be  
2 attached to the PDP-1 computer.

3 As an example in connection with what  
4 we've seen, the left-hand column is titled  
5 "Visual Display Type 30." This is the area that  
6 was earmarked, reserved, for the connection to  
7 the Type 30 display. As I recall, I don't think  
8 it was factory-wired. I believe it was wired on  
9 the site when I brought the display in. But this  
10 came along after our machine was delivered. This  
11 is 7-12-62. These were later factory-wired.  
12 Ours was done, we wired -- or DEC, I believe,  
13 actually wired this same configuration.

14 Q And again, you were referring to the column  
15 marked "Visual Display Type 30"?

16 A Yes. This provides the place where a peripheral  
17 device, either a peripheral device, either a  
18 standard option or user's private device,  
19 customer device, is connected to the PDP-1  
20 computer.

21 Q Referring now to Exhibit 38, could you tell us  
22 what is depicted there, please?

23 A Yes. This is the memory address register and  
24 decoders, BS, PDP-1, Serial No. D-200 -- and the

1 last are not very legible. I would call it a 4.  
2 Q Does that same number appear in the upper left?  
3 A The upper left is a 3. The upper left is  
4 legible; it is indeed. 20003.  
5

6 The memory address register is where  
7 the address is set up so that you can reference,  
8 uniquely reference, one location in core memory.  
9 This time we have a 4,000-word core memory; and  
10 there is enough logic here to uniquely reference,  
11 read out, or store into, any one of those  
12 locations at one time.

13 MR. ANDERSON: Do you mind if I ask:  
14 is that 4,096 cores, or just 4,000?

15 THE WITNESS: 4,096.

16 MR. ANDERSON: 4,096.

17 THE WITNESS: Decimal.

18 MR. ANDERSON: You were rounding it off  
19 to 4,000.

20 THE WITNESS: We talk about 4K core.  
21 I'm sorry.

22 Q Referring now to Exhibit 37, would you tell us  
23 what is depicted there?

24 A Yes. This is the accumulator control, PDP-1,  
BS, Serial No. D-200140B. It's Revision Date

1 6-14-62, initialed EH, Figure D7-3.

2 This is where the control pulses were  
3 transferring, moving, data into, out to, rotating,  
4 shifting, in the accumulator, generating. A  
5 great deal of action takes place in the  
6 accumulator.

7 Q Does the accumulator depicted in Exhibit 37  
8 correspond to the part marked "Accumulator AC(18)"  
9 in the middle right-hand portion of the diagram  
10 on Page 9 of Exhibit 10?

11 MR. ANDERSON: I object. Exhibit 37  
12 I think is entitled "Accumulator Control," not  
13 "Accumulator." I think the question lacks a  
14 foundation.

15 A The register is not shown here; so this block  
16 diagram must indeed be represented by more than  
17 the drawing that I saw. There are 18 flipflops  
18 or bits of accumulator; and that was not in the  
19 control drawings. There is another drawing  
20 somewhere, at least one more drawing, possibly  
21 more, to the block diagram. The control drawing  
22 is not referenced by just -- is not in agreement  
23 with the accumulator block. We must have the  
24 register, too; and I would have to go into detail

1 as to whether indeed this was all the action  
2 necessary.

3 We have carry circuits, complement  
4 circuits, logical transfers. We almost have to  
5 scan this for some time.

6 Q Is what is shown on Exhibit 37 a part --

7 A It's part of this, yes.

8 Q A part of the accumulator?

9 A But not all of it.

10 Q That's fine.

11 Referring now to Exhibit 36, would you  
12 tell us what is depicted there, please.

13 A Yes. In-out register, PDP-1, BS, Serial D-20011-B,  
14 Revision 6-21-62; initialed AB, Figure D7-2.

15 This is the IO, in-out register, which  
16 was used and accessible to programmers as  
17 temporary storage. Probably its principal  
18 function -- well, and it's used later to multiply  
19 and divide. It is in fact an extension of the  
20 accumulator, in some sense; however, it does not  
21 have its own addition carry circuits. It performs  
22 several duties. Most-- I won't say, you can't  
23 say, the most important; but most of the input to  
24 the computer, external to the computer, comes in

1 in the form of the IO; but that by itself is not  
2 the only use of it. It is a register of 18 bits  
3 long. Those are all principal registers in the  
4 machine.

5 Q Is the register depicted --  
6 A Yes.

7 Q -- in Exhibit --  
8 A

9 Q They are the blocks IO<sub>0</sub> through IO<sub>17</sub>.

10 Q The blocks are being represented by the  
11 rectangular dotted lines?

12 A Yes. And that is the flipflop. That is where  
13 the information is temporarily stored.

14 Q Referring to Page 9 of Exhibit 10, is the  
15 register of Exhibit 36 a part of any block in  
16 the diagram?

17 A Yes; the block labeled "In-Out Register."

18 Q That is on Page 9 of Exhibit 10?

19 A Yes.

20 Q Referring to Exhibit 35, would you tell us what  
21 is depicted in that?

22 A The title, "High-Speed Channel Control." We do  
23 not have that.

24 Q Did you say you do not have it, or you did not?

A We do not have it.

1 Q Referring now to Exhibit 34, would you tell us  
2 what is depicted there.

3 A Yes. This is the reader control, the control for  
4 the photoelectric reader; where the information  
5 contained in the hole or no hole in the punched  
6 paper tape is read into the computer.

7 Q Is this a device that reads the tapes that were  
8 identified yesterday?

9 A The reader reads it. This is the interface to  
10 the reader, which is still another device. The  
11 logic on this Exhibit 34 represents the interface  
12 between the reader and the PDP; and in this case  
13 it's only an input. There is no output by the  
14 reader.

15 Q Referring to the diagram on Page 9 of Exhibit 10,  
16 is the reader control of Exhibit 34 part of any  
17 of the devices depicted by blocks in that diagram?

18 A Yes. The bottom of the organization, there is a  
19 block labeled "Tape Reader and Control."

20 Q Referring now to Exhibit 33, would you tell us  
21 what is depicted there.

22 A The title, "Memory Extension." We did not have  
23 this one.

24 Q Referring to Exhibit 32, could you tell us what

1 is depicted in that.

2 A High-speed channel control. We did not have the  
3 high-speed channel.

4 Q Referring to Exhibit 31, this appears to relate  
5 to the high-speed channel control.

6 A It does. The same comments will apply.

7 Q Referring to Exhibit 30, would you tell us if  
8 that depicts any part of the PDP-1 computer at  
9 RLE; and if so, would you tell us what it is.

10 A Yes. Title "MA, MB, IO and MC Transfer Logic,  
11 PDP-1, BS." Serial number, D-2005-E. This is  
12 Revision Date 7-13-62, initialed EH, Figure D6-5.

13 As the title suggests, it's sort of a  
14 catch-all. "MA" refers to the memory address;  
15 "MB" to memory buffer; "IO" to the in-out  
16 register. "PC" is program counter. This is  
17 where the control pulses to handle the exchange  
18 of data are generated.

19 Q Do any of the blocks in the diagram on Page 9  
20 of Exhibit 10 contain any of the parts depicted  
21 on Exhibit 30?

22 A Yes. There is a program counter block. There is  
23 a memory address block; it's labeled "Memory  
24 Address Register." There is a memory buffer

1 register block, and there is an in-out register  
2 block.

3 Parts of the drawing labeled Exhibit 30,  
4 different parts, would fall into any one of those;  
5 would uniquely fall into one of the four blocks,  
6 in accordance with the title.

7 Q Are there labels on Exhibit 30 to indicate the  
8 different parts?

9 A Yes. It is indeed labeled in a helpful fashion.

10 Q Does the "MB" in the upper right-hand portion of  
11 Exhibit 30 show the memory buffer register?

12 A Yes.

13 MR. ANDERSON: I object to the question.  
14 I understood the testimony to indicate that this  
15 was just transfer logic to memory buffer.

16 THE WITNESS: Transfer, yes. May we  
17 just read the outputs?

18 Well, complement -- no; this is unique.  
19 This is special. It's more the multiply-divide  
20 option, which we didn't have at that time, at  
21 the upper right-hand corner.

22 If we come down below that, the first  
23 pulse generated is OMB. That means, cleared  
24 memory buffer.

1           The pulse below that is accumulator;  
2           and the notation means "jam"; the AC jam to  
3           memory buffer. When you do a jam transfer, that  
4           means that you simultaneously transfer the one  
5           side and the zero side of the flipflop. The  
6           reason for doing this is to give a quicker  
7           transfer. It takes time to do a clearing load.  
8           This way you're doing it simultaneously. It  
9           requires more logic.

10           Then that jam transfer is developed  
11           for Bits 0 through 5, another pulse for Bits 6  
12           through 17; and that's because of loading  
13           considerations.

14           Below that, we have "IO 1." There is  
15           an arrow, and "1 MB." That means 10 bits which  
16           are in a "1" are transferred to memory buffer;  
17           relative positions.

18           Is it necessary to go beyond that in  
19           every pulse?

20   Q       No. I would like to ask if the portion of the  
21           PDP-1 depicted in the upper right-hand corner of  
22           Exhibit 30 also is depicted as a part of any of  
23           the blocks on Page 9.

24   A       I testified earlier that it's necessary to look

1 at four blocks to be in accordance with the --  
2 Q Designations?

3 A Designations; in each quarter of the drawing.

4 Q Referring now to Exhibit 29, could you tell us  
5 what is depicted there?

6 A This is the SM/RO logic. I'll define that later;  
7 the program flag and count logic, one-channel  
8 sequence break PDP-1. Within that block is "BS."  
9 It's Serial No. D-20008-D; Revision Date 7-12-62;  
10 initialed EH, Figure D6-4.

11 Again, this is a catch-all. The "SH/RO"  
12 is the shift rotate logic. It's for doing  
13 logical shifting. And --

14 Q Where does that appear?

15 A That appears in the upper left-hand corner. And --

16 Q Does that section where it appears have a label?

17 A Yes; labeled 1D. And the number of places that  
18 you shift are designated, determined, by the  
19 state of the inputs labeled "MB<sub>13</sub>, MB<sub>14</sub>," all  
20 included under a bracket with an oval M-2. So  
21 the programmer at the program console had a  
22 possibility of shifting a bit along up to eight  
23 places if he desired. That's just one part of it.

24 The memory buffer bits are decoded

1 within that same block, 1D; and MBD<sup>ABCD</sup> -- that's  
2 four individual subs, where you bring out the  
3 decoded memory buffer address bits to that in-out  
4 transfer register in one place, where you come  
5 to your own input-output devices.

6 We have earlier testified about sense  
7 switch registers. The inputs from the sense  
8 switches are brought in, and shown on the lower  
9 left-hand corner; SS<sub>1</sub> through SS<sub>6</sub>.

10 A lot more on here. I guess the other  
11 pertinent thing to talk about is that we did  
12 indeed have a one-channel sequence break system;  
13 and this may be of interest. We testified about  
14 the clock. When the action happens here is that  
15 when you want to interrupt a program from a  
16 device external to the computer, you provide a  
17 pulse or a level which is pulsed in later. This  
18 has the effect of stopping the continuity of the  
19 program which is running; or if a program is  
20 running at the time, the continuity of that  
21 program is stopped. The state of the computer,  
22 the major register -- that is, the accumulator,  
23 memory buffer, IO register -- not memory buffer;  
24 you don't need that -- the accumulator, IO register

1 and the program counter are immediately  
2 automatically hardware-transferred to Locations 0,  
3 1, 2, 3 and core; and the program is set up so  
4 that you are dispatched -- well, then your control  
5 is transferred down there. You are dispatched to  
6 what is called a service routine, where you  
7 identify where this interrupt came from. When  
8 you provide the pulse, there is also provision  
9 for providing the status bit. Your service  
10 routine identifies from the status bit which  
11 device is requiring attention; and you then jump  
12 to the service routine to service that device.

13 When that is done, your program  
14 dismisses you from that service device indirectly  
15 back through -- I believe it's Location 0; could  
16 be Location 3 -- where the program counter is  
17 stored. That means you can continue from where  
18 you were interrupted.

19 This is a very important feature.

20 Q Is that sequence break circuitry shown in any  
21 particular section of Exhibit 29?

22 A The input would be down in the same user's in-out  
23 area that we've discussed in Bay 3; actually,  
24 in the lower right-hand corner, I see inputs

1 coming from Location 3H25. That would be one of  
2 the rows of taper pins that we saw on the wiring  
3 diagrams that I referenced earlier. And, well,  
4 that is the input. It goes through B3 and B4.  
5 That is, you count through the break cycles,  
6 since you have to preserve the contents of these  
7 states. You do this with a series, sequence of  
8 cycles.

9 Q Is the sequence break circuitry which you just  
10 described a part of any of the blocks on Page 9  
11 of Exhibit 10?

12 A There is no block provided for sequence break.

13 Q Is it a part of any of the blocks that are shown  
14 there?

15 A No. I consider it a -- it would not properly  
16 fall into any of the headings or titles in this  
17 block.

18 Q Referring to Exhibit 28 --

19 A Unless you take this very broad title, control;  
20 it could. I guess it might fall in there; it  
21 could.

22 Q Referring to Exhibit 28, could you tell us what  
23 is depicted there, please?

24 A Yes. The program counter, PDP-1, BS, Serial

1 D-20009; change number date, 1-26-62, initialed EH,  
2 Figure D6-3.

3 The program counter register points to  
4 where we're going to next. I think we earlier  
5 have mentioned the memory address register as  
6 pointing towards the -- or containing the address  
7 that we're interested in in memory.

8 Usually, the way the program counter  
9 is used in normal sequence, in normal flow of  
10 events, this would contain the next address.

11 Q Is the program counter --

12 A And normally, it's the memory address register  
13 plus one. That is not true of all cycles, but  
14 most; most times. Except there is a branch or  
15 external sequence break. That's a rather general  
16 term.

17 Q Referring to the diagram on Page 9 of Exhibit 10,  
18 is the program counter of Exhibit 28 a part of  
19 any of the blocks indicated in that diagram?

20 A Yes. There is a program block labeled "Program  
21 Counter," "PC, 12" -- and the "12" means that  
22 it's 12 bits long.

23 Q Referring to Exhibit 27, could you tell us what  
24 is depicted there, please?

1 A General control functions, PDP-1, Serial D-20007-B,  
2 change number dates 7-18-62, initialed EH,  
3 Figure D6-1. And this is control. Do you want  
4 to pick out any representative place? I could  
5 talk a long time on this.

6 Q Are the parts depicted on Exhibit 27 parts of any  
7 of the blocks in the diagram on Page 9 of  
8 Exhibit 10?

9 A Yes. This would certainly fall in the block  
10 labeled "Control." But I would expect that there  
11 probably are other drawings that would fall in  
12 there in the same fashion.

13 Q Is it possible to give a general description of  
14 the function of the parts on Exhibit 27, without  
15 going into a lot of detail?

16 A Start across the top. This is a timing chain  
17 for the computer. Remember, in the computer what  
18 we do is set up a series of states; and then  
19 following the setup time the event takes place  
20 at a specific time pulse. This is rather a short  
21 period of time; and the pulse is of the order of  
22 width of a tenth of a microsecond.

23 There is one labeled, here, "Memory  
24 Strobe." Well, there are several pulses which go

1 into the memory module to control events there;  
2 but all action within the computer is governed,  
3 falls on one of the time pulses listed in the  
4 chain process. The time between pulses is  
5 determined by a delay line; which in some cases,  
6 most cases, will fall between -- but in some  
7 places, you'll find dual paths. And where,  
8 again, it's gated or ported, whichever is needed  
9 for where it wants to go.

10 I see some reader logic in here. The  
11 state of the switches on the front panel -- that  
12 is, the start, examine, deposit switches -- are  
13 all shown here. The one flipflop which is very  
14 important -- that's on, that is a one. The  
15 machine is running. However, the machine is  
16 halted when you do an IOT transfer; and depending  
17 whether you elect to have the IOT provide its  
18 own transfer, its own completion, immediately,  
19 let me say provide an immediate completion, or  
20 wait for an occurrence of an event external to  
21 the machine, that will determine how long it's  
22 hung up.

23 There is a label here, "MD Restart."  
24 When we earlier testified to the high-speed

1 hardware multiplier-divide option, when the  
2 multiply or divide instruction is given, control  
3 is transferred down to the rack, card cage, which  
4 contains this hardware. There is a step counter  
5 down there; and it also goes through a series of  
6 pulses. And when this terminates -- and it's a  
7 variable time, depending on how many ones or  
8 zeros you have in the words that are being  
9 multiplied -- that comes back with a restart,  
10 and the computer runs again.

11 There's been testimony as to the  
12 indirect bit. That refers to deferred address;  
13 just a way of explaining the notation of the  
14 flipflops, DF1 or DF2. We can have more than one  
15 level for deferred addressing.

16 Q Where is the timing pulse generated?

17 A The timing pulses are generated across the top.  
18 Normally, the last one, Time Pulse 10, comes  
19 back around and starts Time Pulse 0.

20 The other way it can be started is  
21 shown that there is a label "Start." That's the  
22 start switch. Multiply, divide, restart. At  
23 the same time, this starting the run flipflop is  
24 brought back in and starts the timing chain again.

1 There's a tremendous amount more on  
2 there. Take a long time to cover it.

3 Q Now, referring to Exhibit 26, would you tell us  
4 what is depicted there, please.

5 A Instruction register and decoders, PDP-1; Serial  
6 D-20006-A. Change number date, 5-16-62. I cannot  
7 read the initials. Figure D6-2.  
8

9 And the instruction register contains  
10 the instruction bits of the word; that is, Bits 0  
11 through 4, the five leftmost bits of the word.  
12 This is brought from memory; and you see the  
13 inputs in the vertical tails here. It's  
14 referenced "MB," which is memory buffer register.  
15 We earlier said that that's the link in the  
16 transfer from memory.

17 What happens here is that you bring in  
18 the state of these three bits, and that's decoded;  
19 and the decoding brings, develops, a unique  
20 instruction out here.

21 Q That's in the upper right-hand portion of the  
22 drawing?

23 A And these will be in accordance with the  
24 instructions explained in the PDP handbook,  
Exhibit 10.

1 Q Where are those instructions explained in that  
2 handbook?

3 A General instructions. Better heading, Page 15,  
4 "Standard PDP-1 Instruction List." And the  
5 discussion earlier as an example, the add  
6 instruction -- and I said that the add mnemonic  
7 was used; and I corrected myself from the 20 to  
8 the Code 40. Well, the Code 40 is the hardware  
9 translation. And the add appears on this page;  
10 it should carry with it a notation 40, somewhere.  
11 Indeed it does; yes, in the block 1F12.

12 It shows you how to work through it.

13 Q Referring now to Exhibit --

14 A To complete this --

15 Q Sure; go ahead.

16 A I might just say that when you are decoding the  
17 instruction, the IO register bit zero, IR0,  
18 would be a 1. The following bits, namely IR1  
19 through IR4, would be a zero -- would be zeros.

20 Q And you were referring to parts in the lower  
21 left portion of Exhibit 26?

22 A Yes.

23 Q Referring now to Exhibit 25, would you tell us  
24 what is depicted there?

1 A Yes. This is the accumulator, PDP-1, BS, Serial  
2 20004-B, Revision Date 6-4-62, initialed by EH,  
3 Figure D7-1.

4 This is a drawing referenced by Mr.  
5 Anderson earlier, that was missing when we tried  
6 to tie down everything in the block labeled  
7 "Accumulator," when we only had a picture of the  
8 accumulator control before us. This is the logic  
9 for each of the 18 bits of the accumulator,  $AC_0$   
10 through  $AC_{17}$ .

11 Much more than that. It's the inputs  
12 on these various bits which cover a great many  
13 actions. Your addition is done here. Your  
14 logical shifts, your transfers from the memory  
15 buffer, from the test word, which we had discussed  
16 earlier in control of the Space War, the carry  
17 circuits which are part of the addition circuit,  
18 the program counter from events, are brought in  
19 here.

20 There is a lot of activity here, not  
21 easily explained in a few words.

22 MR. WELSH: I think this would be a good  
23 time for a short break. Off the record.

24 [Recess.]

1 Q Have you worked with any computers other than the  
2 TX-0 and the PDP-1?

3 A Yes; but it's all at a time following the period  
4 which has been covered in the testimony.

5 Q You mean the time when you worked with the TX-0 --

6 A Well, the times we've been discussing during the  
7 testimony, my full time was occupied between the  
8 TX-0 and the PDP-1 computer. Since that time,  
9 I've spread out to cover more machines.

10 Q Now, when you say "the time we've been talking  
11 about," what time do you mean?

12 A Well, I consider we've been talking about the  
13 period September 1961 through sometime like  
14 probably -- Dave Gross' tape had a date '65.

15 We've talked employment dates beyond that, but I  
16 think the exhibits fell somewhere within that  
17 time frame.

18 Q You did discuss, however, that you had worked on  
19 the TX-0 prior to that time for some years?

20 A No. My testimony there was that in the spring  
21 of 1958, an April weekend -- whether April was  
22 later, earlier, I'm not sure -- I was brought  
23 back earlier from Eglin Air Force Base so that I  
24 could begin to familiarize myself with the TX-0

1 computer at Lincoln Laboratory and begin to  
2 prepare and make ready to be brought, transferred--  
3 moved is a better word, in this case, to the MIT  
4 campus.

5 Q And then, did you continue to work with the TX-0  
6 when it was moved?

7 A Yes. That was my sole job the first -- until the  
8 PDP-1 arrived.

9 Q In 1961?

10 A Yes.

11 Q That was my understanding.

12 A Yes.

13 Q What computers have you worked on since the period,  
14 since 1965, other than the PDP-1 or TX-0?

15 A Yes. RLE has three PDP-9 computers which I  
16 maintain; and of course they have a great deal of  
17 input-output, a lot of it specialized input-output,  
18 which was in most cases the result of a student  
19 thesis, at the graduate level, some of it fairly  
20 sophisticated.

21 In that same complex, there is a PDP-11-40  
22 There is a PDP-8, which is part of an optical  
23 reader. It's a commercial configuration put out  
24 by the ECRM Corporation, Bedford, Mass. That was

1 a gift to the RLE. And as I've testified, it's  
2 a page reader; and a control for that is a PDP-1  
3 which has been -- well, additional input-output  
4 facility has been added. In that complex, there  
5 was also a Tempo computer used with the Biology  
6 group. The manufacturer is now General Telephone.  
7 Q And you worked on -- excuse me.

8 A Well, as well as maintaining them, I interface  
9 equipment to them.

10 As a matter of fact, all of my time is  
11 allocated up there now. We are building a small --  
12 not really special-purpose, but part of it was  
13 a special-purpose SSP computer; which is built --  
14 high-speed echo logic -- for Professor John  
15 Allen. And the interest in this is providing a  
16 facility that will be fast enough for real-time  
17 speech. The hope is, you know, in the final  
18 configuration, that you will read in a page of  
19 printed, typewritten copy, through the auto  
20 reader, tied in through what will currently be  
21 a PDP-9 computer; probably sometime later a more  
22 up-to-date machine. And the PDP-1 computer  
23 interfaces to the special SSP computer; and the  
24 processing will be done at a high enough speed

1 that the quality of the speech output will be  
2 highly improved.

3 My interest in that is that it's  
4 currently being packaged. I did not do the  
5 original design for it. We have two technicians  
6 working on it. I am preparing -- I did all the  
7 drawings on it. I prepared stuff for them, and  
8 I'm worried about the implementation.

9 And I have designed the interface to the  
10 PDP-9. This is going from echo logic to  
11 immediate TTO logic, and then to a PDP-9; which  
12 is the negative logic, DEC's negative logic, such  
13 as the PDP-1.

14 This is not solely mine. There is a  
15 graduate thesis being carried on by Jack Allbeiss;  
16 and this is quite a -- talking about a small  
17 package; the logic is quite extensive. And he has  
18 a program. The end result is that we type -- the  
19 computer types out a wiring list. But much more  
20 than that, that's only an output from it. His  
21 program is given macro descriptions of the  
22 elements or blocks that are used in it; and the  
23 programs determines the best utilization of the  
24 connections, and carries a description of the

1 logic. And so I am participating, rather than  
2 having any direct charge. It's a cooperative  
3 effort.

4 Q Mr. McKenzie, are the PDP-8, PDP-9 and PDP-11  
5 computers of DEC manufacture?

6 A Yes, they are.

7 Q You used the term "macro." Is that an assembly  
8 program --

9 A It's one of the features of an assembly program.  
10 This means that when you first write the program,  
11 you write a title of the macro, and provisions  
12 for the arguments that you wish to pass to the  
13 macro. Then you give a list of code and terminate  
14 the macro.

15 When you use it thereafter, you just  
16 call this set of instructions by the given name,  
17 and the arguments are passed with it; and it's not  
18 necessary for you to type in the long list of  
19 code.

20 Q Now, I believe you referred earlier to  
21 demonstrations of Space War on the PDP-1 at RLE.  
22 Did those demonstrations occur during the period  
23 of September 1961 through June 1963, which was  
24 the period of the logbooks, Exhibits 4 through 7?

1 MR. ANDERSON: I object. The question  
2 is vague, indefinite, uncertain as to time;  
3 covering a large period of time.

4 A Certainly the first demonstrations could not have  
5 demonstrated Space War. I think the first game  
6 that we had on the machine was a game Kalah.  
7 That was something that Daniel Edwards, earlier  
8 mentioned, brought up. And this is -- I believe  
9 this is some sort of an Indian game where you  
10 move stones between two pits; and this is a  
11 computer simulation of it. There were games  
12 available; not a great deal of interest.

13 Q After the Space War program was written and  
14 Space War had commenced to be played, were there  
15 demonstrations of Space War?

16 A Yes. If we had visitors coming through,  
17 depending on the nature of the activity on the  
18 machine at the time. If there was some research  
19 activity, we'd be pretty selective as to whether  
20 we interrupted it. But depending on the nature  
21 of events, the nature of the visitors and the  
22 nature of the activity on the machine, we might  
23 have interrupted things. If it could have been  
24 scheduled in advance, we would certainly have

1 accommodated visitors. We did, various groups.  
2 Q Were there times when there were large numbers of  
3 visitors for scheduled events?  
4

5 MR. ANDERSON: I object. The question  
6 is vague and indefinite as to the meaning of the  
7 terms. It's clearly leading, and it amounts to  
8 testimony.

9 A During the public open house, which is generally  
10 held every other year at MIT, we attract large  
11 numbers of visitors; and even prior to the time  
12 we had the PDP-1, we had demonstration programs  
13 running on the TX-0. And it was not unusual at  
14 times to have the room so packed that you  
15 couldn't get another person in the room.

16 Q Was any of these demonstrations of Space War at  
17 an open house ever the subject of an article in  
18 any publication at MIT that you know of?

19 A Yes. The open house is a student-conducted  
20 affair. We always found students to do the  
21 narration and conduct the games. Of course, I was  
22 always in and made sure the machine was running.  
23 And there was a student committee formed with a  
24 representative from each lab and a sort of a  
governing body or something; and they, after we

1 generated the publicity, they come around before-  
2 hand -- what have you got to offer? Each lab is  
3 expected to contribute.

4 The students themselves have some  
5 ideas; and the program is determined or made up.  
6 And there is generally advance publicity on this.

7 Q Do you remember any particular occasion of any  
8 article referring to Space War?

9 A Certainly at one -- I know that at more than one  
10 of our open houses we did have Space War. The  
11 reason that I recollect is that it turned out not  
12 to be a very good demonstration. It was great  
13 for attracting a lot of people; but when you have  
14 a large number of people, it's not very  
15 interesting for the people in the perimeter of  
16 the crowd; and really not much of interest to  
17 anyone other than the users. And we got a couple  
18 of people down front, we had to almost bash them  
19 in the head to get them out of those seats.

20 But we did have -- it's clear from  
21 that recollection that it wasn't the best  
22 demonstration program. We had to put in a  
23 variety program.

24 Q I hand you what was marked as Exhibit 2 in the

1 Samson deposition, which is a Tech Talk dated  
2 April 25, 1963. Do you recall having seen that  
3 issue of Tech Talk?

4 A Yes, I have seen this. I see all of them. Even  
5 when I'm on vacation, they're saved for me. I  
6 find them.

7 Q Do you recall seeing that particular issue?

8 A Yes. I was always interested in things pertaining  
9 to our machine; and it would have been discussed.

10 Q Do you find therein a reference to Space War?

11 MR. ANDERSON: Objection; the document  
12 speaks for itself. The witness has not testified  
13 that, other than as a general practice, he saw  
14 all of these Tech Talks. I think the question  
15 lacks a foundation.

16 A Yes. There's a photograph on the front page  
17 showing the PDP-1 display; and, well, the caption  
18 "Peter Samson" -- or "Dan Edwards and Peter  
19 Samson of RLE, two originators of 'Space War,'  
20 play the game."

21 This scene shows the two spaceships  
22 colliding. The photograph has been double-  
23 exposed. The reason for that is that the double  
24 exposure is not to big things; but it's very

1 difficult to photograph a scope face, because of  
2 flicker rate and this sort of thing. The lighting  
3 that you want for the scope face is not the  
4 lighting that you want to show the people.

5 One interesting thing here, I haven't  
6 been referencing it; but I've been discussing  
7 these control boxes made up by the students there  
8 operating the control box, earlier referenced.  
9 Of course, there is a write-up. I see spaceships  
10 included in the write-up.

11 Q Does the write-up refer to an open house?

12 MR. ANDERSON: Objection.

13 A Yes. The first paragraph, "The occasion" -- the  
14 end of the first paragraph, "The occasion, MIT's  
15 twenty-second open house"; and the date,  
16 Saturday (April 27) from noon to five. And "MIT  
17 students expect to advise and usher over 25,000  
18 people from the Greater Boston area around the  
19 MIT campus."

20 Q Do you recognize either of the persons depicted  
21 in the photograph in the lower left corner of the  
22 front page of that Tech Talk?

23 A Yes.

24 Q Who do you recognize them to be?

1 A Well, it is as the caption says, states; Dan  
2 Edwards and Peter Samson -- making the comment  
3 that they're dressed up. One of the few occasions  
4 you'd ever see these fellows with a white shirt  
5 and a coat. They really cooperated with us.  
6 Usually pretty casual.

7 Q Do you recognize them apart from the caption  
8 beneath the --

9 A Oh, yes. Yes. I've known them well. They were  
10 around for a long period of time.

11 Q Do you recall any occasion at RLE when this  
12 picture was taken?

13 A I've seen many pictures taken there. I noticed  
14 that the photo was taken by Bob Lyons, Robert  
15 Lyons, of Photo Service. He's been in the room  
16 many times. I have no special recollection of  
17 this one time. It was -- well, I always remember  
18 that problems -- trying to focus the scope face,  
19 which I mentioned earlier. He does quite good  
20 work.

21 Q Do you recall an open house having been held on  
22 April 27, 1963?

23 A Yes. It was customary to have a public open house  
24 every other year; and in many of the in-between

1 years we had a parents' weekend, which was an  
2 open house, more restricted number of people in  
3 it. I always came in those Saturdays and made  
4 sure that everything was all right. I was there  
5 for the duration. But we did try to get students  
6 to operate the show, shall we say; run the show.  
7 Q Do you recall being present on that particular  
8 occasion?

9 A I've been present every open house since 1958,  
10 all of the time.

11 Q Would the logbook containing entries for that  
12 date, April 27, 1963, contain any entry which  
13 would indicate whether the PDP-1 was used for  
14 demonstration purposes or not?

15 MR. ANDERSON: Objection. You're  
16 asking the witness to speculate.

17 A I earlier looked at that page. There is an entry  
18 that I was in there that morning. It was a  
19 Saturday; I do not come in every Saturday. There  
20 is no specific mention of an open house. I think  
21 there is a -- I know that there is a block of  
22 time where there is no list of users, as we  
23 normally see. I did look at the TX-0 log for  
24 the same date; and the TX-0 log, there was a

1 reference that Professor Thomas Stockin had been  
2 running the open house on the TX-0 computer that  
3 afternoon.

4 Q And what significance did that have?

5 A Well, this showed me that indeed --

6 MR. ANDERSON: I object. That's asking  
7 him to speculate, render opinions. It's hearsay,  
8 irrelevant and immaterial.

9 A The TX-0 logbook indicated that there was an open  
10 house on April 23. Is that the date you're  
11 talking about? The advertisement, maybe it's the  
12 27th.

13 Anyway, I was interested in '63;  
14 April 27, '63.

15 Q Referring to Exhibit 1 and the date of April 28,  
16 1962, do you find anything there to indicate  
17 usage of the PDP-1 at an open house?

18 MR. ANDERSON: Please reread the  
19 question.

20 [Question read.]

21 Q I'm sorry; Exhibit 5, it should be.

22 THE WITNESS: Would you read the date  
23 for me?

24 MR. ANDERSON: Read the whole question.

1  
2 [The pending question was read back as  
3 follows:

4 "Q Referring to Exhibit 5 and the  
5 date of April 28, 1962, do you  
6 find anything there to indicate  
7 usage of the PDP-1 at any open  
8 house?" ]

9 MR. ANDERSON: Object to the leading of  
10 the witness, improper reliance on the document,  
11 hearsay, speculation and expressions of opinion.  
12 A May I once more ask: Is the date April 28? The  
13 reference in the Tech Talk, we've been talking  
14 the year 1963; and we have a logbook for the year  
15 1962. Is this what we wanted?

16 Q Could you read the entries for April 28, 1962?

17 MR. ANDERSON: I object to the witness  
18 reading the entries. The document speaks for  
19 itself.

20 A All right; yes. April 28, '62; Page 49 of  
21 Exhibit 5.

22 "12 noon Saunders for open house." It's  
23 initialed, "RAS 1800. Greenblatt off." And the  
24 quotations under it, "for open house," initialed  
by Greenblatt.

1  
2 And the custom was that we had, as I  
3 earlier testified -- that we had a public open  
4 house one year and a parents' open house weekend  
5 on the alternate years.

6 Q Do you recall any open house on that date?

7 A I do not recall that. I know that I personally  
8 was at every open house, pretty much an annual  
9 affair for me; and that it was standard time here,  
10 12 to six, 1200 to 1800 -- though it's usually  
11 advertised as 1200 to 1700.

12 Q Do you know whether Space War was demonstrated  
13 at that open house?

14 A I have earlier seen a tape with a date --

15 MR. ANDERSON: Mr. McKenzie, I think  
16 if you'd just answer the question.

17 MR. WELSH: I think he's . . .

18 MR. ANDERSON: Will you reread the  
19 question, please.

20 [Question read.]

21 A Knowing the people involved, I know that there  
22 would have been an all-out effort to have Space  
23 War available at that open house. I cannot  
24 testify for sure that that was available. Knowing  
the situation at that time, it most very likely

1 was played.

2 Q Now, you have met Mr. James Williams, one of the  
3 attorneys here at this table, have you not?  
4 A Yes.

5 Q Did you have a discussion with Mr. Williams  
6 yesterday in the hall during one of our recesses?  
7 A Yes, I did.

8 Q Could you relate that discussion as best you  
9 recall, stating what he said and what you said  
10 from the beginning of the discussion?

11 A Yes. As we were more or less intermingled out in  
12 the hallway, Mr. Williams passed by and smiled  
13 and said "Do you remember Spass?" I immediately  
14 responded "Yes; Ray Tomlinson." And mentioned  
15 his association with Ray Tomlinson. Spass was  
16 Ray Tomlinson's master's thesis. There's already  
17 testimony about that particular thesis.

18 Q Did Mr. Williams state further what his  
19 relationship with Mr. Tomlinson had been?

20 A Yes. It was words to the effect that "I worked  
21 with Ray," or something.

22 Q Did he -- excuse me.

23 A I'm not sure it was much beyond that. Sort of  
24 remembered him after that.

1 Q Did he state whether he worked with Mr.  
2 Tomlinson on Spass?

3 A That was not specifically stated, as I remember.  
4 Q Do you recall anything else that was said during  
5 that discussion?

6 A Not during that discussion. I think we were  
7 beginning to get together at that time.

8 Oh; I possibly mentioned Ray was --  
9 Ray's current job location as being BB&N,  
10 Cambridge. I think Mr. Williams was aware of it.

11 Q Have you any agreement with any party to this  
12 suit, or any understanding, that you or MIT will  
13 be compensated for the time that you have spent  
14 preparing for and appearing at this deposition?

15 A No. I did receive a check accompanying the  
16 subpoena, in the amount of \$21. I think it's in  
17 the name of a constable.

18 It's made out to me personally;  
19 Constable Richard M. Percoco, P-e-r-c-o-c-o,  
20 Constable Susan Percoco, Post Office Box 26,  
21 Cambridge, Mass. 02141; the date October 16, 1973,  
22 payable to the order of -- pay to the order of  
23 John A. McKenzie, \$21, signed by Richard M.  
24 Percoco.

1 MR. WELSH: That completes my direct  
2 examination.

3 Mr. Herbert?

4 MR. HERBERT: I have nothing.

5 MR. WELSH: Mr. Anderson, would you  
6 like to cross-examine?

7 MR. ANDERSON: We have some cross, yes.

8 MR. HERBERT: Fifteen minutes?

9 CROSS-EXAMINATION

10 BY MR. ANDERSON:

11 Q Mr. McKenzie, just a few minutes ago I think you  
12 testified that you searched through the TX-0 log  
13 and the PDP-1 log prior to testifying here to  
14 determine what entries were made for April 27,  
15 1963; is that correct?

16 A Yes. The attachment indicated Tech Talks of  
17 about that point in time. I thought that the  
18 discussion might lead in that area, lead to that  
19 area.

20 Q Did anyone suggest that you search those logs  
21 to see what entries were made on that date?

22 A No. I recognized, as I've testified earlier --  
23 I was somewhat disturbed by this attachment and  
24 at what I thought could be a particularly broad

1 interpretation. I was disturbed enough by it to  
2 call Mr. Robert Shaw about it. I felt that I had  
3 some compulsion to comply, and in some sense I  
4 couldn't begin to comply with all of it. I  
5 wanted to make some -- read into it, produce at  
6 least some of the material, representative, at  
7 least, of what was subpoenaed, I guess.

8 Q Attachment A consists of two numbered paragraphs,  
9 1 and 2. Did both of those paragraphs cause you  
10 that concern, or just one of them?

11 A No. I think, well, the first paragraph,  
12 terminating the -- something like "or any other  
13 game using a computer and cathode ray tube  
14 display and known existing or played at  
15 Massachusetts Institute of Technology prior to  
16 1972" -- my layman's interpretation, that might  
17 mean anywhere from 100 to 1,000 computer games  
18 played with a display. I felt that that was  
19 rather a broad interpretation.

20 Paragraph 2 I did not have ready access,  
21 or within my own files, all that, the volumes of  
22 Tech Talk mentioned; and it would have required  
23 quite a bit of time on my part to do this. I  
24 think the testimony of the first part of the first

1 day showed how that was resolved.  
2

3 I had received a call from the  
4 Secretary, Mr. Arthur Smith's secretary, that  
5 she was looking into this angle. But I guess  
6 that was probably based on -- well, when I  
7 expressed my concern to Mr. Robert Shaw, he came  
8 over that afternoon. I read a copy of the  
9 attachments. It was -- I didn't have to worry  
10 about it from then on.

11 Q You're certainly correct; Attachment A,  
12 Paragraph 1, does refer to all documents and  
13 things relating to "Space War" or any other game  
14 using a computer and a cathode ray tube display  
15 and known, existing or played at MIT prior to  
16 June 1972.

17 Now, was your difficulty only with  
18 respect to those other games, other than Space  
19 War?

20 A Not solely. We've had a large number of display  
21 hacks -- I've defined the term "hack" earlier,  
22 I think, in testimony. It was not unusual for a  
23 new user, at least, on the PDP-1 to have some  
24 kind of a computer display output to show how  
this program was operating. Whether they could

1 be classified as a game or not, I'm not sure.  
2 Many times, you use switches to cause changes in  
3 the program. One of them would create what you  
4 might think of as wallpaper designs, constantly  
5 changing geometric shapes and patterns. This  
6 could be broadened into a large number of games.

7 Q Yes; and that is my question. Was it those other  
8 games, other than Space War, that caused your  
9 difficulty in interpreting Paragraph 1 of  
10 Attachment A?

11 A Yes. That expresses it more clearly than I did.

12 Q Thank you.

13 Then, with respect to Space War, did  
14 you make a full, complete production as far as  
15 you know of all documents and things relating to  
16 Space War from the beginning up to June of 1972,  
17 as far as you know?

18 A I did not. There are a large number of users'  
19 tapes in our cabinets. I say "tapes"; I mean  
20 paper tapes, and more recently small DEC tapes.  
21 It hasn't been defined in this testimony. These  
22 are private property of the users; and I'm sure  
23 that a large number of those tapes, the user has  
24 his private copy of Space War. Whether it was

1 modified by him or just copied from somebody else,  
2 I'm not sure. But there are a large number of  
3 them in existence.

4 Q Are they in your possession, or the possession of-  
5 and property of -- MIT?

6 A They're in an open drawer, and labeled with the  
7 students' names. They're really the students'  
8 private, personal property; although most of  
9 these students have graduated and departed.

10 Q In what room are they located?

11 A 26-260.

12 Q Is there anything else that you have not  
13 produced today relating to Space War, other than  
14 what you've just mentioned?

15 A Yes. There's a demonstration tape hanging on a  
16 pegboard where we have a series of DEC tapes  
17 mounted. The demonstration program, the tape  
18 labeled "Demo," contains a copy of Space War.

19 Q When was that made, do you know?

20 A The tape was made two or three years ago. Which  
21 version of Space War it has, I'm not sure. It's  
22 not unusual, as I've stated, for several  
23 different students to have private versions.  
24 That's the one that would commonly be used now.

1 Q Were the other private versions that you said you  
2 know are in various drawers made two or three  
3 years ago?

4 A They have been made from the time we got DEC tapes  
5 up to, possibly even as recently as sometime last  
6 year -- last year being the academic year '74-'75.  
7 We had a fair number of students around at that  
8 time. We have not now.

9 Q When you say "DEC tapes," is that a specific  
10 type of tape?

11 A Yes. It's a trade name for a magnetic tape which  
12 is wound on a spool about five inches in diameter.  
13 The tape is three-quarters of an inch wide, and  
14 it's 260 feet in length; and there are four DEC  
15 tape transports on our PDP-1 computer, and these  
16 DEC tapes have become the users' private library.  
17 We also use the DEC tapes for the community  
18 library. That is, the DEC tapes have replaced  
19 the need for the punched paper tape.

20 The only reason for now using punched  
21 paper tape is when you want to obtain a listing  
22 of your source program. You can punch it out  
23 from the Expensive Typewriter's text buffer. I've  
24 testified to this earlier. Carry it on an off-line

1 Flexowriter and produce a listing similar to the  
2 Exhibit 9 -- Exhibits, well, 9-1-A and 9-2-A.

3 Q When was the first DEC tape transport added to  
4 the PDP-1 in Room 260?

5 A Sometime after the middle of the 1960's, we  
6 actually ordered and had on hand a DEC tape  
7 transport. We were -- it's necessary, of course,  
8 in interfacing the DEC tape to the computer, to  
9 have a control. Rather than buy a standard DEC  
10 tape control, a common control was designed by  
11 Professor Jack Dennis; and this control allowed  
12 for expansion of up to 16 DEC tape units, and a  
13 common area where the data transfer could only  
14 occur from any one transport to or from any one  
15 transport at one time -- but you could be  
16 positioning the other transport to bring it up to  
17 the block required.

18 The DEC tapes have this property, that  
19 there is a series of clock pulses recorded on  
20 one of the tracks, block identification numbers  
21 on another track; so that you can uniquely  
22 address sections of the DEC tape. And to repeat  
23 myself, you can be positioning these DEC tapes  
24 to the desired location while you're actually

1 transferring data to or from another DEC tape.  
2 Q Does the PDP-1 in Room 260 still have a punch  
3 tape input?

4 A Yes. We still have the paper tape reader. I use  
5 for maintenance programs, diagnostic programs.

6 Q Is the paper tape input used for operating  
7 programs, if that's a proper term?

8 A No. However, it's not -- if a user had punched  
9 out a copy of his program to list on the off-line  
10 Flexowriter, that same paper tape could be read  
11 into the PDP-1 utilizing the paper tape reader,  
12 and the information would go back into the  
13 Expensive Typewriter's text buffer.

14 Most usually, though, the user would  
15 be working from his DEC tape. It's much faster  
16 and more reliable.

17 Q Can the program for the PDP-1 be read either from  
18 source language tapes or binary tapes into the  
19 machine to operate the machine?

20 A Let me answer by qualifying that a little bit.  
21 You can read a source language tape into  
22 Expensive Typewriter's text buffer; and then you  
23 have to, under control of either Expensive  
24 Typewriter or -- well, usually from Expensive

1 Typewriter -- call for a copy of the assembly  
2 program; have the source language text, order  
3 code, assembled under control of the assembly  
4 program, currently called Certainly; and the  
5 output of the assembly program is the machine  
6 language binary tape.

7  
8 We would not now bother to punch a  
9 paper tape. We do not even keep around a copy  
10 of the binary tape. It's so easy to read from  
11 your English text, and assemble it.

12 As a matter of fact, for instance, if  
13 we had a tape mounted on the uppermost tape  
14 transport, labeled Zero, if you turn on the  
15 console, you automatically get a copy of the  
16 debugger program which serves as a monitor. If  
17 you type in a zero, numerical zero, upper case F,  
18 the tape transport zero will start spinning.  
19 If you know the title under which you have filed  
20 the wanted program, typing N space title carriage  
21 return will automatically bring this source  
22 language program into Expensive Typewriter's  
23 buffer; and immediately pass control to the  
24 assembler. The assembler will transfer it; and  
when all this is done, you have a carriage return

1 and you can proceed from that point. That is,  
2 you will be under control of the debugger program--  
3 i.e., doing an upper case P at that time, the  
4 program will proceed.

5 You also have a copy of your program  
6 in your user pseudofield zero, so that you can --  
7 if your copy of a program in core is modified or  
8 destroyed -- if I said zero, I meant one -- by  
9 doing a 101 capital U, that means field one on  
10 save -- you will get a fresh image, such as was --  
11 the same copy that just passed from the assembler.

12 MR. WELSH: Excuse me, Mr. Anderson.

13 MR. SMITH: I'm sorry.

14 MR. WELSH: It is after five now. I  
15 don't know if we're going to keep to the schedule.

16 MR. ANDERSON: All right. Let me ask  
17 one more question.

18 Q Why was Expensive Typewriter called Expensive  
19 Typewriter?

20 A Yes. At the time it was written, we had no  
21 time-sharing system; and it was really a waste  
22 of computer time to sit and let a sole user  
23 interact with the computer. The computer was  
24 probably not working -- well, something less than

1 5 percent of the time; and maybe that is even too  
2 generous an amount. It becomes more feasible to  
3 do when you have a time-sharing system, where the  
4 resources of the computer can be shared between  
5 several users.

6 Q I guess I'm still not clear why it was called  
7 Expensive Typewriter.

8 A Well, it was not doing much -- well, it was an  
9 easier type operation. But you were using the  
10 computer to do something that you could also do  
11 off line, on the off-line Flexowriter; except  
12 that you didn't have the ease of editing which  
13 the computer allowed.

14 Q And it was this Expensive Typewriter that was  
15 necessary to convert source language to binary  
16 language?

17 A No. The assembler; the assembler tape. It's  
18 carried several names. When we first had the  
19 machine, the title of the assembler tape was  
20 Macro. That went through several phases. We had  
21 another assembler called Midas. Also, Eric  
22 Jensen came along and wrote a version called  
23 Possible. That stayed around for a while. We  
24 had another student come along and wrote his

1 version; he called his Certainly. And that became  
2 the accepted version used today.

3 I'll try to make it a little bit more  
4 clear. This is the program that takes the source  
5 language tape produced either on the off-line  
6 Flexowriter, or could be produced from the  
7 Expensive Typewriter, and converts it to the binary  
8 tape. This binary tape can be read into the  
9 computer by just hitting the read switch, if you  
10 have a computer without -- not in time sharing,  
11 but a raw computer, it needs no input routine or  
12 anything. Everything is self-contained.

13 However, if as we are now, in the time-  
14 sharing system, you can do an upper case Y --  
15 that is, Yank -- this binary tape; and your  
16 program will be resident in your core area.

17 MR. ANDERSON: We'll let the rest go  
18 until morning.

19 MR. SMITH: Let me ask a question off  
20 the record.

21 [Discussion off the record.]

22 [Whereupon, at 5:10 p.m., the deposition  
23 was adjourned to Thursday, October 30, 1975, at  
24 9:00 o'clock am., at the same location.]

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C E R T I F I C A T E

I, John Alexander McKenzie, do hereby certify that I have read the foregoing transcript of my testimony, Pages 182 to 350, and further certify that said transcript is a true and accurate record of said testimony.

Dated at Cambridge, Massachusetts,  
this 8th day of December, 1975.

John Alexander McKenzie  
John Alexander McKenzie

Sworn and subscribed to before me this 8th  
day of December, 1975.

Lillie J. Ferris  
Notary Public  
My commission expires:

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